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# The Engineer.

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Vol. CXXXIV.—No. 3490] LONDON: FRIDAY EVENING, NOVEMBER 17, 1922 [Price One Shilling By Inland Post 1s. 3d.

PUBLIC NOTICES

**The High Commissioner** for India is prepared to receive TENDERS for the SUPPLY of :—

1. WHEELS and AXLES, 5ft. 6in. Gauge.
2. MILD STEEL BARS, ROUND, HOT SAWN, for REINFORCED CONCRETE.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday, the 5th December, 1922, for No. 1, and Thursday, the 7th December, 1922, for No. 2.

T. RYAN,
Director-General.

737

**Assistant Civil Engineer** REQUIRED by the GOVERNMENT of the GOLD COAST for Railway and Harbour Works Construction, for one tour of 12 to 18 months, with possible extension. Salary £1200 per annum. Free quarters and passages and liberal leave in England on full salary. Candidates, age 25 to 45, possessing considerable electrical and mechanical knowledge, together with experience in the design, lay-out, construction and maintenance of railway and harbour works, including plant for same, also a sound acquaintance with timber, steel, and other materials used in engineering construction, should apply in writing to Messrs. STEWART and McDONNELL, 6/7, Cowley-street, Westminster, London, S.W. 1. 760

**Royal Naval Engineering** COLLEGE, KEYHAM (PLYMOUTH). APPLICATIONS are INVITED for the following POSTS :—

1. SENIOR LECTURER in ELECTRICAL ENGINEERING, who, under the organising Naval Engineer Officer, will, in addition to giving lectures, advise on equipment of laboratories and workshops and assist in arranging the studies and practice in Electricity and Electrical Engineering.

Good university degree and practical experience essential. Salary £850-£1000 by £25 annually inclusive of bonus, with superannuation benefits under the Federated Universities Superannuation Scheme.

2. LECTURER in ENGINEERING SUBJECTS, particularly Applied Mechanics, Mechanism, Heat and Steam.

Candidates should possess a good Honour Degree and have had experience in engineering practice and teaching. Salary £400-£600 by £25 annually, inclusive of bonus, with superannuation benefits as above.

3. DEMONSTRATOR in Engineering Laboratory, particularly in connection with the Mechanical Testing of Metals. Some experience of elementary electrical and chemical laboratory work also desirable. Salary £250-£350 by £20 annually, inclusive of bonus, with superannuation benefits as above.

Applicants should state age, qualifications, and furnish full particulars of similar appointments held, and forward copies of testimonials and references not later than 27th November to the SECRETARY of the ADMIRALTY (C.E. Branch), Whitehall, S.W. 1.

P8464

**The Institution of Municipal** AND COUNTY ENGINEERS.
CONDITIONS OF ADMISSION.

NOTICE is HEREBY GIVEN that a RESOLUTION to AMEND the BY-LAWS will be proposed at the 50th Annual General Meeting, restricting admission to separate membership to engineers who possess a professional diploma or certificate, or university degree, awarded after examination by some responsible body in addition to professional experience. Particulars may be obtained from the undersigned.

J. W. DUDLEY ROBINSON,
Secretary of the Institution.

22, Victoria-street,
Westminster, S.W. 1.
8th November, 1922. 768

**The Institute of Physics.**

APPOINTMENTS REGISTER AND REGISTER OF CONSULTING PHYSICISTS.

The Appointments Register Committee is prepared to recommend to Public Departments, Universities and Colleges, Directors of Research, Manufacturers, and others desirous of employing or consulting fully qualified Physicists, suitable persons possessing special knowledge of any branch of physics.

By Order of the Board,
F. S. SPIERS,
Secretary.

10, Essex-street,
London, W.C. 2. 488

**Metropolitan Water Board.**
CONDUIT—LITTLETON TO HAMPTON.

The Metropolitan Water Board invite TENDERS for the CONSTRUCTION of about 35 YARDS of TWIN 9ft. diameter REINFORCED CONCRETE CONDUITS and about 2900 LINEAL YARDS of 72in. REINFORCED CONCRETE CONDUIT from Littleton to Kempton; also the LAYING only of about 2000 YARDS of 48in. diameter CAST IRON PIPE from Kempton to Hampton; together with a CONCRETE INTAKE CHANNEL to the Staines Aqueduct and for contingent Works.

Drawings, conditions of contract, and specification may be inspected without payment of fee at the offices of the Board, Chief Engineer's Department (Room 201), on and after Monday, 20th November, 1922.

Copies of drawings may be obtained at the cost of the tenderer through the Board's Photo Printers. Forms of Tender, conditions of contract, specification, and bills of quantities, together with a spare copy of the bills of quantities, may be obtained on and after 20th November, 1922, from Mr. Henry E. Stillgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £20, which sum must be deposited with the Accountant to the Board and will be returned on receipt of a bona fide Tender, accompanied by the above-named documents (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer), together with all copies of drawings obtained by the tenderer.

Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 Noon).

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, London, E.C. 1," and endorsed "Tender for Conduit, Littleton to Hampton," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 1st January, 1923.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
10th November, 1922 741

## The Engineer

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Non-Metallic Enclosures in Steel.

High G.W.R. Train Speeds.

A New Form of Viscometer.

Single-Blow Pneumatic Power Hammer.

PUBLIC NOTICES

**Bengal-Nagpur Railway Company, Limited.**

The Directors are prepared to receive TENDERS for :
(1) STEEL TYRES.
(2) ENGINE TYRES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 14th November, 1922.

A fee of £1 1s. will be charged for each specification, which will not be returned.

Tenders must be submitted not later than Noon on Monday, 27th November, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
R. C. VOLKERS,
Secretary.

743

**Great Southern and Western** RAILWAY (IRELAND).
CONTRACTS, 1923.

The Directors of the Great Southern and Western Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for three months, commencing 1st January, 1923, and alternatively for six months commencing the same date :—

| | No. of Form. |
|---|---|
| Acid, Sulphuric | 3D |
| Asbestos Sheeting, &c. | 4B |
| Baskets | 10 |
| Bolts, Nuts, and Rivets | 15 |
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| Brass Fittings for Carriages | 18 |
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| Do. do. for Gas | 26B |
| Canvas and Sacks | 6 |
| Castings, Mall. Iron | 11 |
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| Glass, Sheet, and Plate | 27A |
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| Leather | 12 |
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| Plumbago | 41 |
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| Ropes, Twine, and Flax | 4 |
| Soaps | 8C |
| Sewer Pipes, Plaster of Paris, &c. | 32 |
| Shovels, Spades, &c. | 21A |
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| Waterproof Clothing | 9B |
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| Wire, Fence, and Signal | 30A |
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Forms of Tender can be obtained on payment of 6d. each from the Stores Superintendent, General Stores Department, G.S. and W.R., Inchicore, Dublin. Applications for forms by post must be accompanied by postal order. Stamps cannot be accepted. All inquiries for information should be also directed to the Stores Superintendent.

Patterns may be inspected at the General Stores Department on and after the 17th inst., between the hours of 10 a.m. and 4 p.m. (except on Saturdays).

Tenders must be enclosed in the special envelope supplied for the purpose with each schedule, and must be posted so as to be with the undersigned before 10 a.m. on Wednesday, 29th November, 1922.

The Directors will not consider any Tender unless it is furnished on the Company's form, and do not bind themselves to accept the lowest or any Tender.

By Order,
ROBERT CRAWFORD, Secretary.
Kingsbridge Terminus, Dublin,
November, 1922. 754

PUBLIC NOTICES

**State Electricity Commission** OF VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/5.—HIGH-PRESSURE STEAM, DRAIN AND FEED PIPING, VALVES, TRAPS, &c.

Charge.—£2 2s. for the first two copies complete with Tender forms, conditions of contract, specification and drawings. This charge is returnable on receipt of a bona fide Tender. A third or any further copies will be supplied for the sum of £1 1s. each, but this charge is not returnable.

Preliminary Deposit.—A preliminary deposit of £50 is to be lodged with the Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 24th January, 1923.

R. LIDDELOW,
Secretary.

State Electricity Commission of Victoria,
Melbourne, Victoria, Australia. 639

**State Electricity Commission** OF VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 22/3.—SWITCHGEAR AND ACCESSORIES.

Charge.—£2 2s. per set of three copies complete with Tender forms, conditions of contract, specification and drawings. This charge is returnable on receipt of a bona fide Tender. A fourth or any further copies will be supplied for the sum of 10s. 6d. each, but this charge is not returnable.

Preliminary Deposit.—A preliminary deposit of £25 is to be lodged with the Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m. on the 15th January, 1923.

R. LIDDELOW,
Secretary.

State Electricity Commission of Victoria,
Melbourne, Victoria, Australia. 680

**City and Borough of Peterborough.**
ELECTRICITY DEPARTMENT.

FOR IMMEDIATE DISPOSAL :—

ONE 500-Kilowatt Willans-Siemens Geared D.C. TURBO-GENERATOR and CONDENSER.

ONE Musgrave INDUCED DRAUGHT FAN, direct coupled to Willans 3-CRANK ENGINE.

ONE Direct-acting COMPOUND BOILER FEED PUMP, by J. F. Hall and Sons, 5000 gallons per hour capacity.

TWO 7in. Gwynne CENTRIFUGAL PUMPS, direct coupled to 15 H.P. D.C. MOTORS.

ONE 9in. Gwynne CENTRIFUGAL PUMP, direct coupled to 40 H.P. D.C. MOTOR.

Full particulars of above may be obtained on application to the ENGINEER and MANAGER, Electricity Department, Albert Meadow, Peterborough. P6456

PUBLIC NOTICES

**City of Leicester Waterworks.**
EVINGTON SERVICE RESERVOIR.

The Water Committee are prepared to receive DESIGNS and TENDERS for the CONSTRUCTION of a COVERED SERVICE RESERVOIR of 5,000,000 gallons capacity at Evington, near Leicester.

General information and conditions to be observed in submitting designs and Tenders, together with key and contoured plans of site can be obtained on application to the undersigned.

Designs and Tenders, addressed to the Chairman of the Water Committee, Waterworks Office, Bowling Green-street, Leicester, must be received not later than 10 a.m. on December 7th, 1922, endorsed "Tender for Evington Reservoir."

The Water Committee do not bind themselves to accept the lowest or any Tender, nor to reimburse contractors for any expense they may incur in preparing Designs and Tenders.

G. T. EDWARDS, M. Inst. C.E.,
Water Engineer.

Waterworks Office,
Bowling Green-street, Leicester 606

**East Indian Railway.**

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 6th December proximo, TENDERS for the SUPPLY of—

LATHES.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.

73-76, King William-street,
London, E.C. 4.
15th November, 1922. 774

**Swansea Harbour Trust.**

The Trustees invite TENDERS for the SUPPLY and DELIVERY of the following :—

About 105 TONS of 80 lb. FLAT-BOTTOMED SECTION RAILS.
About 65 CWT. SHALLOW FISH-PLATES to match.
About 85 TONS of 80 lb. BULL-HEAD SECTION RAILS.
About 67 CWT. SHALLOW FISH-PLATES to match.
About 100 TONS New Slightly Defective 80 lb. FLAT-BOTTOMED SECTION RAILS with FISH-PLATES to match.
4830 New CREOSOTED SLEEPERS, 9ft. by 10in. by 5in.
About 42 TONS CAST IRON RAILWAY CHAIRS, approximately 444 lb. each.
10 STOP BLOCKS complete.

Further particulars may be obtained of the Trustees' Engineer, Mr. A. O. Schenk, M.I.C.E., Harbour Offices, Swansea.

Tenders, sealed and marked "Railway Material," to be delivered to the undersigned on or before 4th December, 1922.

The Trustees do not bind themselves to accept the lowest or any Tender.

TALFOURD STRICK,
Clerk.

Harbour Offices, Swansea,
November 15th, 1922. 755

**The Assam-Bengal Railway** COMPANY, Ltd., is prepared to receive TENDERS for :—

(1) 3 FIRST and SECOND COMPOSITE and 25 THIRD-CLASS BOGIE CARRIAGES.
(2) 132 PAIRS WHEELS and AXLES.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 63, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Friday, the 8th December, 1922.

The Directors do not bind themselves to accept the lowest or any Tenders.

By Order of the Board,
OSWALD I. MILNE,
Secretary.

17th November, 1922. 770

**The Egyptian Ports and Lighthouses** REQUIRE, for work at Suez, a SECOND-HAND SELF-LOADING DREDGER, in good condition. Specification and Tender form can be obtained from—

THE INSPECTING ENGINEER,
Egyptian and Sudan Governments,
Queen Anne's Chambers,
Westminster,

where Tenders will be received up to Noon on the 30th November, 1922. 731

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## PUBLIC NOTICES

**The Great Indian Peninsula RAILWAY COMPANY.**
**ELECTRIFICATION OF BOMBAY SUBURBAN LINES.**

The Directors are prepared to receive TENDERS for the SUPPLY of the following PLANT, namely :—

| | Fee for Specification. |
|---|---|
| 1. ELECTRICAL EQUIPMENT of COACHES | £2 |
| 2. OVERHEAD EQUIPMENT of PERMANENT WAY and OVERHEAD DISTRIBUTION LINES | £2 |

Specifications and forms of Tender may be obtained at this office on and after 20th November, 1922, on payment of the fee for the specification, which payment will not be returned.

Contractors may Tender for either or both of the above sections.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Electrical Equipment of Coaches," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 9th January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

The Consulting Engineers, to whom applications for any further technical information may be made, are Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W. 1.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 14th November, 1922. 757

**The South Indian Railway Company,** Limited, are prepared to receive TENDERS for the SUPPLY of :—
1. SWITCHES, CROSSINGS, and C.I. CHAIRS.
2. STEEL SCREW COUPLINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Switches, Crossings, and C.I. Chairs," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 1st December, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1 and 2.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
16th November, 1922. 756

## SITUATIONS OPEN

WANTED, GENERAL MANAGER, by Firm of Electrical and General Engineers, makers of dynamos and motors, employing about 200 hands. State age, salary expected, and past experience, which it is essential shall have been of a similar nature. Replies in confidence.—Address, 725, The Engineer Office. 729 A

WANTED, TWO ASSISTANT ENGINEERS on Construction of Large Masonry Dam in India. Applicants should be unmarried, should have experience in Concrete and Masonry, also some mechanical experience, and should be technically qualified. Salary about Rupees 600 per month, according to experience, with furnished quarters.—Write, Z. A. 257, care Deacon's, Leadenhall-street, E.C. 3. 1758 A

OLD-ESTABLISHED FIRM of Reinforced Concrete Specialists have a VACANCY on their outdoor staff for ASSISTANT REPRESENTATIVE for the East Midlands district. Applications are invited from gentlemen having an established connection with architects, engineers and contractors, and a knowledge of civil engineering (preferably reinforced concrete work). State age, experience and salary required.—Address, P6451, The Engineer Office. P6451 A

SALES REPRESENTATIVE WANTED for Birmingham and Midland area. Must be practical engineer, with connection in the district and experience in selling engineering specialties. Salary, expenses and commission will be paid. Energetic man who will work the district properly can make the position of increasing value.—Address, with full particulars, 750, The Engineer Office. 750 A

STRUCTURAL STEEL WORK.—Experienced DRAUGHTSMAN WANTED AT ONCE, Westminster, accustomed Steel-frame Buildings, Bridges, &c.; able to take off quantities rapidly. Permanency to suitable man.—Address, stating age, experience, and salary required, 776, The Engineer Office. 776 A

THE TECHNICAL DIRECTOR of the CHATWOOD SAFE CO., Ltd., Bankers' Engineers, Bolton, REQUIRES an ASSISTANT as WORKS ENGINEER, who has had actual experience in dealing with plant methods of manufacture and rate fixing in a well-organised engineering works.—Applications will receive confidential consideration and must be addressed to the MANAGING DIRECTOR. 773 A

WORKS MANAGER REQ., Ltd. Co., Capital £19,000, London. Invest £1000 ord. shares. Salary £520 and dividend. Service agreement. Light engineering to make power units, sprockets, motor engines and cycles. Also SALES CONTROLLER, same invest, and terms. Refs. req.—Messrs. TURNFIELD, 23, Gt. Tichfield-st., Oxford-circus, London. 778 A

WORKS SUPERINTENDENT REQUIRED IMMEDIATELY for production of Motor Car Engines and Gear-boxes. Only men fully competent in this class of manufacture need apply. State age, wage, and experience, and when able to commence duties.—Address, P6469, The Engineer Office. P6469 A

CHIEF DRAUGHTSMAN for Bridge and Constructional Work (Midlands). Must be fully experienced, good organiser and estimator. State age, reference, and salary required.—Address, P6471, The Engineer Office. P6471 A

CONSTRUCTIONAL DRAUGHTSMAN: Must be experienced man with thorough knowledge of the Design and Construction of all types of Steel Structures. State age, experience, and salary required.—Address, 761, The Engineer Office. 761 A

DRAUGHTSMEN (Age 28/40 years) REQUIRED for manufacturing side of General Engineering Work; must be thoroughly conversant with Static and Rotary Sub-station Lay-outs, Cable Arrangements and Details. Experience of Power Station Lay-out an advantage. State full particulars and salary required. —Address, 694, The Engineer Office. 694 A

DRAUGHTSMAN WANTED for Temporary Work AT ONCE. Only those having experience of Design of Small Mechanism or Instruments need apply; knowledge of acetylene or gas an advantage. State experience fully, age, salary, and when free.—Address, P6472, The Engineer Office. P6472 A

WANTED, FOUNDRY FOREMAN, Experienced in Moulding Large Marine Castings and General Heavy Machine Tool Castings.—Apply, THE SHEEPBRIDGE COAL and IRON CO., Ltd., Chesterfield. 764 A

WANTED, FOREMAN PATTERNMAKER, Experienced in Heavy Marine Engine, General Machine Tools, and Special Pipe Patterns.—Apply, THE SHEEPBRIDGE COAL and IRON CO., Ltd., Chesterfield. 765 A

FOREMAN ENGINEER REQUIRED in London Factory, capable of taking charge of maintenance of buildings and machinery (mills, cranes, &c.). Must have knowledge of Electricity, D.O. experience, and able to control men.—Address, P6463, The Engineer Office. P6463 A

## SITUATIONS WANTED

A.C.W.A., Experienced in Cost Organisation of engineering, steel smelting, foundry work, &c., DESIRES POST as Cost Accountant or Secretary-Accountant. Excellent experience and references. Would consider two or more firms within a reasonable radius, of combined strength 1500 hands.—Address, P6449, The Engineer Office. P6449 B

A.M.I. MECH. E. (36) DESIRES Responsible POST, Victoria, Australia; 8 years shops, general eng. (2 years in charge), 14 years D.O., purchasing dept., lay-outs, estimates, specs., tenders, corres., trials.—PERRY, 29, Charlton-lane, Charlton, S.E. 7. P6426 B

AUTOMOBILE ENGINEER SEEKS RE-ENGAGEMENT; experienced in design for economical production of light and heavy vehicles; sound works experience; with prominent firms since 1899.—Address, P6474, The Engineer Office. P6474 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-street, E.C. 758 B

CIVIL ENG., A.M.I.C.E., with 14 Years' Experience, would invest up to £1000 on 1st mort. deb. in sound company which could advantageously utilise his full time services. Accountants' investigation required.—Address, P6472, The Engineer Office. P6472 B

DEMONSTRATOR or TRAVELLER.—GENTLEMAN (33), engineer, practical, DESIRES POSITION as above; excellent references.—Address, P6438, The Engineer Office. P6438 B

ENGINEER, Age 28, with Technical and Practical experience, steam, gas, electrical, general engineering, millwrighting and repair work; highest references; 1st Class B.O.T. Certificate; shore experience.—Address, P6459, The Engineer Office. P6459 B

ENGINEER, Good Experience, Office and Shops, hydraulic, structural, cranes, buildings, furnaces, lay-outs, would ACCEPT TEMPORARY.—Address, P6478, The Engineer Office. P6478 B

ENGINEER, to Take Charge of Heavy Oil or Gas Engines.—Address, P6462, The Engineer Office. P6462 B

ENGINEER (23), 6 Yrs. Loco. Shops and D.O., knowledge of auto. work; passed A and C Sections, Inst. C.E. exam. Any position to get a start.—BRAMBLES, Stock, Essex. P6467 B

FULLY Qualified, Up-to-date ENGINEER (32), holding responsible position, SEEKS new APPOINTMENT. First-class exp. design, estimating, control of labour 7 years press tools; ex. refs.—Address, P6450, The Engineer Office. P6450 B

MAINTENANCE ENGINEER (40), First Class B.O.T., with extensive knowledge of maintenance and running of all types of steam and gas plants; also capable of conducting economy investigations on same and applying results therefrom, DESIRES responsible APPOINTMENT at home or abroad. Excellent references.—Address, P6460, The Engineer Office. P6460 B

MANAGING DIRECTOR of Large Engineering Company highly RECOMMENDS his CHIEF ASSISTANT, age 32, a university man of business ability, highest chemical qualifications and engineering experience, possessing initiative, imagination and knowledge for position of scope and responsibility. Unassailable references.—Address, P6441, The Engineer Office. P6441 B

MECH. and ELEC. ENGINEER (49). Single. A.M.I. Mech. E., A.M.I.E.E., expert on Diesel and all classes of int. com. engines, experienced engineer in steam and elec. plant, D.O., structural and loading plant, railway, locos., rolling stock, workshop and all mining plant, last post 9 years chief engineer of large mining co. abroad, SEEKS ENGAGEMENT, home or abroad. Energetic and sound constitution.—Address, P6426, The Engineer Office. P6426 B

QUALIFIED MECHANICAL ENGINEER (32), educated Public School and Technical College, trained shops and drawing-office, DESIRES CHANGE; extensive experience at home and abroad; commercial experience in steel and machinery trades. Capable technical linguist.—Address, P6417, The Engineer Office. P6417 B

£6 PER WEEK SECURES LIVE MAN; 10 Years' administration as department manager and chief D.O.; general engineering, railway experience, steam and petrol engines; age 36; first-class references.—Address, P6455, The Engineer Office. P6455 B

WITH Ability and Application, YOUNG GRADUATE in Arts and Civil Engineering, varied experience, steel and concrete structural work, piling, railroads, earthworks, &c., pupil of large city corporation, DESIRES POST with liveable salary anywhere.—Address, P6477, The Engineer Office. P6477 B

YOUNG MAN (19), Keen, Energetic, Matriculated and studying for degree, DESIRES POST in London as Tracer or Junior Draughtsman.—8, 60, Verdant-lane, Catford, S.E. 6. P6476 B

WANTED, POSITION as JUNIOR DRAUGHTSMAN, by a G.I.M.E., age 21, with works and university training; good references; nominal salary for a trial period.—Address, P6468, The Engineer Office. P6468 B

FIRST-CLASS DRAUGHTSMAN (30), 13 Years' exp., motor cars, jig and tools and special machinery, SEEKS SIT.; best refs. and diplomas.—Write, P. L., 21, Great Western-terrace, W. 10. P6473 B

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# Some Recent Developments in Cross-Channel Steamer Design.

No. I.

If reference be made to any annual list of the mercantile steamships of the world, subdivided according to their speeds, it will at once be seen that, excluding a mere handful of large liners, practically the entire number of vessels capable of high absolute speed are those owned by the railway companies operating the traffic routes between Great Britain and the Irish or continental ports. There are, it is true, a few vessels exceeding 20 knots speed in service abroad, but they are mainly isolated examples, and do not, as the British vessels do, form fleets of ships possessing particular individual characteristics. The war diminished considerably the number of large merchant vessels with speeds of over 20 knots, and also took toll of many fast Channel steamers of the "Queen," "Connaught" and "Ben-My-Chree" types, so that in point of total number there are, in spite of new construction, actually fewer fast vessels available to-day than in former years. The cross-Channel traffic, however, is one that always demands high speed, and the relative cost of obtaining it compared with that of the total trip between London and an Irish or continental destination is much less than on the North Atlantic, where the voyage is virtually the entire journey. Among existing Channel steamers there are twelve which attained 24 knots and over on trial—some exceeded 25 knots—and about eight which exceeded 23 knots; some sixteen made between 22 and 23 knots on trial. But it is not only in high absolute speeds, but in high relative speeds as well, that the Channel steamers are remarkable. Torpedo craft alone excepted, many of them are the fastest vessels afloat in proportion to their length as well as in absolute speed; even the latest light cruisers, though certainly several knots faster, have the advantage of a much greater length on which to develop their speed, so that their 29 knots on 450ft. is relatively a little less than the 24 to 25 knots of some of the latest Channel steamers the overall length of which does not exceed 300ft.

Starting with the local Clyde services from Greenock to Rothesay and Campbeltown and from Ardrossan to Belfast in the north-west, the so-called "Channel" steamers ply from almost every port round the British Isles until, leaving the South and proceeding up the East Coast, we reach the Harwich-Antwerp service of the Great Eastern Railway Company. None of the other East Coast services, such as the Harwich-Esbjerg, Grimsby-Hamburg, or the Hull and Newcastle services to Scandinavia and Denmark, are so essentially "cross-Channel" services, though the design of ship is, except for speed, not unlike those of some of the vessels on the railway routes. All these are time services; that is, the vessels leave at fixed times independent of tides, a condition essential to a frequent and rapid service, but one which has only been obtained (*a*) by gradual improvement in harbour accommodation, for all the ports mentioned are tidal, and (*b*) by adopting in some cases a very restricted draught of water and selecting times of departure which do not coincide with low water of spring tides. On the one hand, harbour facilities have exercised a marked influence on Channel steamer design, and on the other, the impossibility of improvement at certain ports has resulted in limitations to increase in size of ship of a very drastic nature.

The conditions which govern the design of vessels employed on these services are fairly uniform as regards their general application, though they differ considerably in detail with the actual route on which the ships are employed. Thus, for instance, though the Holyhead-Kingston route covers the same sea distance as that between Newhaven and Dieppe and demands the same high speed, the local conditions as to nature of service or permissible size of ship are very different. The Irish vessels require ample sleeping accommodation and are largely unrestricted as to length and draught, whilst the Dieppe boats are rigidly limited in dimensions. It is for this reason of local suitability that the exigencies of post-war recuperation have witnessed the transfer of few Channel steamers of pre-war design to fill the gaps created in other fleets. Only a few instances of interchange are found. The St. George has been transferred from the Great Western Company's Fishguard service to the Great Eastern Company's Harwich line; the Viper of the Burns' Ardrossan service is now the Snaefell, of the Isle of Man Steam Packet Company's service; the Onward, of the South-Eastern and Chatham Railway Company's Folkestone route, is now the Mona's Isle; but it is only in isolated instances such as these that the designs appropriate to one line meet the requirements of another.

The general considerations affecting the design of Channel steamers may be summarised as follows:—

(1) Length of voyage.
(2) Nature of voyage.
(3) The necessity for maximum possible passenger-carrying capacity.
(4) The provision for high speed on trial and in service.
(5) Owing to the frequency of entering and leaving port, the necessity for (*a*) small net register tonnage, and (*b*) ample manœuvring capacity.

On certain services special conditions introduce distinctive features into the design; thus we find, for instance:—

(*a*) At Ostende, the draught of water for normal displacement is rigidly restricted to under 10ft. Lengths up to 350ft. are permissible.

(*b*) At Dieppe the length has always been restricted as well as the draught. The former has only developed in the last twenty-five years from 280ft. to 305ft. overall; the draught has not been allowed to exceed 9ft. 8in.

(*c*) The rough weather encountered in the Irish Sea has always necessitated ample freeboard on these routes; ample depth of water, however, is always available.

(*d*) Special provision for handling mails or registered baggage may or may not be required.

(*e*) Terminal coaling facilities may involve carrying fuel for the round trip independent of length of run.

(*f*) The varying necessity of working to a precise time-table may introduce different margins between service and maximum speed.

(*g*) In some cases—*e.g.*, Dover-Ostende or Holyhead-Kingston—full speed can be maintained from pier to pier. In others, such as Liverpool to the Isle of Man, full speed must not be maintained between the Rock Light and the Bar Lightship, nor, after passing Flushing on the way up the Scheldt to Antwerp, can the Great Eastern Railway steamers proceed fast.

### Passenger Accommodation.

It is in the never-ceasing increase of traffic that we find the *raison d'être* of the Channel steamer fleets of to-day compared with those of twenty and thirty years ago. Improvement in design was very considerable in the years immediately preceding the war, but the interruption to travel and construction caused thereby has prevented more than a comparatively small number of new designs being placed in service in the last few years. These designs, however, show very marked progress over many of their predecessors and their technical features contain numerous items of interest. Strange as it may appear at first sight, the growth in absolute size has been much less rapid than might have been anticipated, and in point of length and displacement the figures have remained comparatively stationary over a long period, the new London and North-Western Irish mail boats forming an exception to this rule. It has been rather in the developments of improvements in propelling machinery that greater speeds and carrying capacities have been rendered possible on similar dimensions, while as regards the important feature of passenger comfort there has been a very considerable increase in standard of excellence. If we review the conditions governing design in the light of their applicability to the various services, we find an obvious difference between (*a*) purely day service vessels and those designed for both day and night work, and (*b*) between the short distances services and those whose length of sea trip involves the provision of proper sleeping accommodation.

The last consideration has an important influence on the whole design, as it largely affects the question of suitable speed—*i.e.*, machinery and the space that can be devoted to it—as well as of size and arrangement of ship. If the night service trip exceeds about three hours, sleeping accommodation is necessary, and considerable space and weight must be devoted to the provision of ample cabins and their equipment. The longer journeys entail more elaborate saloon and cooking accommodation with all the extra storage capacity involved, and space is an important consideration in these small vessels. In the short service craft ample deck space with plenty of shelter against wind and weather and plenty of sofa accommodation in the main cabins is all that is necessary, the provision of private cabins being necessarily much more restricted. The tendency, however, even on these fast vessels which are not specifically of the night service type, is to increase the private accommodation, and on the continental services the extra charge therefor has recently been out of all proportion to the total fare between the termini.

The necessity for providing for large numbers of passengers reaches its maximum, perhaps, in the Isle of Man Steam Packet Company's vessels, in which, at the height of the summer excursion traffic, a passenger load of between 150 and 200 tons may sometimes have to be handled. The crowding of the South Coast Channel steamers is inevitable. Restricted in size and necessarily limited in their number of trips per day, it is impossible to avoid the discomforts which often attach to these journeys. An extra boat train and steamer service will not obviate it at holiday times, simply on account of the general preference of the public to travel at certain hours. Dover Harbour Station handles an enormous number of travellers during the summer months, with perhaps three South-Eastern and Chatham Railway and two, and sometimes three, Belgian State Railway steamers in and out each day. Night service boats of the Great Eastern Railway or Belfast Steamship Company's type do not suffer to the same extent in this respect, because, heavy as the traffic often is, the individual has always his sleeping cabin to himself; on other services even standing room is sometimes scarce. In the lighter class of coastal pleasure steamers the necessity for providing adequate structural strength against these heavy deck loads has sometimes been under-estimated, and strengthening has often been required. This aspect of passenger capacity is not precisely what is meant by condition (3) above, which relates more particularly to the fact that provision must be made in the design for carrying a sufficient total permissible number of passengers from the financial point of view. When this number must be accommodated in sleeping berths the space factor in design assumes important proportions, and much ingenuity has recently been displayed in attempting to squeeze the proverbial quart into a pint pot.

### Speed.

Speed is naturally of fundamental importance in the design, owing to the power required for a given speed and displacement increasing so rapidly as the length of ship diminishes, and owing to the large proportion of the displacement which must be devoted to the machinery weight. In this respect Channel steamers are particularly susceptible to small changes in length. Thus, for instance, on a displacement of, say, 2400 tons at a service speed of 22.7 knots, the increase of power involved by reducing the length from 360ft. to 340ft. is about 7 per cent., and from 340ft. to 320ft. a further 13 per cent., while a reduction to 300ft. would be quite impracticable, as the power required would need to be at least 40 per cent. more than for 360ft. The combined effect of the two influences increases very rapidly. For the day services the demand is necessarily for the highest speed within reason; on the night services there is less object in it, there being, in most cases, no additional saving in working hours to the passenger except at considerable increase of discomfort. Where the sea passage is long enough to justify "turning in" at all it may be just as convenient to do so for a couple of hours longer, particularly when the vessel leaves after 10 p.m.; the alternative, occasioned by more powerful machinery and consequently less passenger accommodation, can only be a distinct increase in cost of journey coupled with the necessity of "turning out" at some inconveniently early hour. The London to Belfast services *vid* Liverpool or Heysham, or London to Antwerp or Flushing, are cases in point; there is no object in a very early morning arrival after a late departure. On the other hand, on the long sea route by Newhaven-Dieppe to Paris, the very high speed of the vessels brings the London-Paris journey down to the same total time as that taken on the shorter sea trip routes which have to contend with the longer railway journeys. The highest speeds now attained with this class of ship was 24 and 25 knots. It is somewhat remarkable that this former speed was reached as long ago as 1905 by the Princess Elizabeth on a length of 344ft.; the Rouen made over 24 knots on 292ft. in 1912; so did the Stad Antwerpen on 300ft. in 1913; the Paris, also of 300ft., passed 25 knots in the same year. These performances are remarkable. In absolute speed the Paris has since only been approached by the new London and North-Western Railway Company's vessels of the "Anglia" class, which were put on the Holyhead-Dublin service in 1920–21. These ships, however, are 380ft. long and considerably more than twice the displacement of the 1500-ton Paris, whose speed-length ratio of 1.45 is only exceeded by torpedo craft.

### The Development of Railway Steamers.

The history of these small railway steamers is as intimately connected with that of the growth of travel or the development of naval architecture as that of any other class of ship, but in many cases they have often proved to be in advance of current practice in respect of machinery design. The fact that, in spite of all the mechanical improvements which have been introduced in the last thirty years, the absolute size of Channel steamers on the various routes has hardly increased except in isolated cases renders it of some interest to follow their development from the very beginning. Many of the older vessels were remarkable examples of both ship and machinery. In tracing the influence of machinery on design the earlier developments were possibly of a more far-reaching nature than the later ones, but much of the real improvement in modern vessels is obscured by the fact that the standards of comfort and safety which so radically affect vessels of this type are difficult to compare.

The great stages of cross-Channel steamer development may be roughly divided as follows:—

(1) The introduction of twin-screw engines in lieu of paddle engines about 1887.
(2) The introduction of the Parsons turbine in 1903.
(3) The introduction of the water-tube boiler in 1910.
(4) The introduction of the geared turbine in 1911.
(5) The combination of water-tube boilers and geared turbines in 1913.

In searching back to the earliest days of the cross-Channel services we find that the same companies whose post-war steamers are the acme of their type to-day were also among the first in the field of marine engineering, the South-Eastern Railway Company, the City of Dublin Steam Packet Company, the Isle of Man Steam Packet Company, &c., all owning steamers running on the same routes to-day as they ran seventy and eighty years ago. Amongst the earliest vessels were the Lady Lansdowne and

# THE DEVELOPMENT OF CHANNEL STEAMER DESIGN.

TABLE I.

| When built. | Name and owner. | Length. | Beam. | Depth | Dr'ught. | Displacement. | Speed. | I.H.P. or S.H.P. | Revolutions. | Engines. Type. | Engines. Cylinder or rotor diameters. | Boilers. Number. Pressure. | Boilers. H.S. G.S. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft. in. | ft. in. | ft. in. | ft. in. | Tons. | | | | | | | | |
| | City of Dublin S.P. Co.— | | | | | | | | | | | | | |
| 1833 | Lady Lansdowne | 133 0 | 17 0 | 9 6 | — | 148 | — | 90 | — | Paddle | — | — | — | |
| 1834 | Garryowen | 130 0 | 21 6 | 9 3 | — | 263 | — | 90 | — | Paddle | — | — | — | |
| 1848 | Cambria | 196 0 | 27 0 | 14 6 | — | 716 | — | 370 | — | Paddle | — | — | — | St. Columba in 1847 was practically identical. |
| 1860 | Ulster | 334 0 | 35 0 | 19 0 | 12 7 | 1890 | 17.8 | 4,200 | 27.0 | 2-cylinder oscillating | (2) 96in. by 84in. | Box type, 30 lb. | — | Sister ships, Munster, Connaught and Leinster. |
| 1867 | Kildare | 240 0 | 27 0 | 14 7 | — | 868 | — | 300 | — | 2-cylinder oscillating | — | — | — | |
| 1885 | Ireland | 360 0 | 38 0 | 19 2 | 13 9 | 2410 | 20.2 | 6,350 | 28.0 | 2-cylinder oscillating | (2) 102in. by 102in. | Box type, 30 lb. | 22,750 807 | 200 first-class passengers. |
| 1897 | Ulster | 360 0 | 41 6 | 17 3 | 13 3 | 2200 | 22.7 | 9,150 | 175 | Two 4-cylinder triple-expansion | 29in., 45in., (2) 48in by 33in. | 4 D.E. cyl., 175 lb. | 16,480 520 | Sister ships, Munster, Connaught and Leinster, all built by Laird Bros. |
| | L. and N.W. Railway Co.— | | | | | | | | | | | | | |
| 1863 | Alexandra | 222 5 | 28 0 | 16 1 | — | 857 | — | 320 | — | Paddle | — | — | — | |
| 1875 | Rose | 290 4 | 32 0 | 15 6 | 10 10 | 1540 | 16.3 | 3,015 | 27.0 | Paddle | — | — | — | Shamrock, sister ship. |
| 1880 | Lily | 300 6 | 33 0 | 14 0 | 10 9 | 1450 | 18.2 | 3,120 | 29.0 | Paddle | — | — | — | Violet, sister ship. |
| 1884 | Banshee | 310 0 | 34 0 | 14 2½ | 11 0 | 1500 | 20.4 | 4,850 | 30.0 | Paddle | — | — | — | First return voyage Holyhead-Dublin, 18.5 knots, 3500 I.H.P., 1570 disp't. |
| 1887 | Olga | 300 0 | 33 0 | 13 8 | 8 10 | 1150 | 16.25 | 1,950 | 100 | Two 3-cylinder triple-expansion | — | — | — | |
| 1900 | Anglia | 330 0 | 39 0 | 16 6 | 11 5½ | 2340 | 21.2 | 7,173 | 173 | Two 4-cylinder triple-expansion | 26in., 40in., (2) 43in. by 33in. | 8 S.E., 160 lb. | 15,000 430 | Cambria, Hibernia and Scotia, sister ships, all built by Denny Bros. |
| 1920 | Anglia | 380 6 | 45 3 | 18 6 | 13 9 | 3570 | 25.0 | 15,650 | — | Geared turbines, 2 screws | — | 9 B. and W., 200 lb. | 33,016 | Cambria, Hibernia and Scotia, sister ships, all built by Denny Bros. |
| 1900 | South Stack | 290 6 | 36 0 | 13 6 | 11 0 | 1750 | 16.2 | 2,950 | 137 | Two 4-cylinder triple-expansion | 19in., 29½in., (2) 33in. by 30in. | — | — | Snowdon, Caltee More. |
| 1912 | Greenore | 306 0 | 40 6 | 15 6 | 11 5 | 2050 | 20.5 | 7,500 | 630 | 3-shaft turbines | — | 5 B. and W. | 15,910 538 | Passenger and cargo-carrying type, working on the Holyhead-Greenore route. |
| 1919 | Curraghmore | 307 1 | 40 1 | 15 6 | 11 6 | 2100 | 21.0 | 7,100 | 350 | 2-shaft geared turbines | — | 5 B. and W. | — | |
| | Isle of Man S.P. Co.— | | | | | | | | | | | | | |
| 1853 | Manx Fairy | 163 0 | 23 0 | 12 6 | — | 417 | — | 200 | — | Paddle | — | — | — | Ramsey I.O.M. Co. |
| 1854 | Ellan Vannin | 170 0 | 20 0 | 9 9 | — | 336 | — | 100 | — | Paddle | — | — | — | Castletown S.P. Co. |
| 1882 | Mona's Isle | 331 0 | 38 2 | 15 1 | 10 6 | — | 19.0 | — | — | 2-cylinder compound | 65in., 112in. by 90in. | 90 lb. | — | Also Mona's Queen. |
| 1897 | Empress Queen | 360 0 | 42 4 | 17 0 | 13 0 | 2940 | 21.3 | 11,000 | 44.0 | 3-cylinder compound | 92in., 68in., 92in. by 84in. | 6 S.E., 120 lb. | 12,660 360 | Average service speed 20. |
| 1905 | Viking | 350 5 | 42 0 | 16 1 | 11 0 | 2400 | 23.53 | * | 430 C. 450 W. | 3-shaft turbine | K = 73. H.P. 48in. L.P. 68in. | 4 D.E. | 19,712 610 | Average service speed 22.2. |
| 1908 | Ben-my-Chree | 375 0 | 46 0 | 18 6 | 13 5 | 3353 | 24.12 | 14,700 | 455.0 | 3-shaft turbine | H.P. 47in. L.P. 67in. | 4 D.E., 170 lb. | 27,446 754 | Passenger capacity 2500. |
| 1912 | Snaefell | 270 0 | 41 6 | — | 11 6 | 2075 | 19.4 | 4,375 | 163.5 | Two 4-cylinder triple-expansion | — | — 195 lb. | 11,100 302 | |
| 1913 | King Orry | 300 0 | 43 0 | 15 0 | 12 6 | 2550 | 20.75 | 8,000 | 300.0 | 2-shaft geared turbines | K = 100. H.P. 14in.-23in. L.P. 37in. | 2 D.E., 1 S.E., 170 lb. | 14,385 383 | Turbine revolutions, H.P. 2210, L.P. 1617. |
| | Midland Railway Co.— | | | | | | | | | | | | | |
| 1904 | Donegal | 330 0 | 42 0 | 18 0 | 11 0 | 2550 | 21.9 | 8,400 | 185.0 | Two 4-cylinder triple-expansion | 23in., 36in., (2) 42in. by 30in. | 2 D.E., 1 S.E., 200 lb. | 12,461 402 | Antrim, sister ship. Average service speeds 19.3 to 19.6. |
| 1904 | Londonderry | 330 0 | 42 0 | 18 0 | 11 0 | 2400 | 22.27 | * | 670 C. 750 W. | 3-shaft turbine | — | 2 D.E., 1 S.E., 150 lb. | 12,461 402 | Average service speed 19.7. |
| 1904 | Manxman | 330 0 | 43 0 | 18 0 | 11 0 | 2489 | 23.00 | * | 530 C. 610 W. | 3-shaft turbine | — | 2 D.E., 1 S.E., 200 lb. | 12,461 402 | Average service speed 20.3. |
| | L. and Y. Railway Co.— | | | | | | | | | | | | | |
| 1844 | Royal Consort | 216 0 | 29 2 | 16 0 | — | 796 | — | — | — | 2-cylinder oscillating | (2) 71.5in. by 66in. | — | — | |
| 1878 | Earl of Ulster | 275 0 | 30 2 | 14 5 | 10 0 | 1107 | — | — | — | Two 2-cylinder compound | (2) 34in., 64in. by 72in. | — 70 lb. | — | |
| 1897 | Duchess of Devonshire | 300 0 | 35 0 | 15 0 | 9 9 | 1720 | 19.0 | 5,000 | 175.0 | Two 3-cylinder triple-expansion | 21in., 32in., 50in. by 30in. | 2 D.E., 200 lb. | 8,000 257 | Lancaster, 1894, 24in., 36in., 55in. by 33in. by 160 lb. = 5400 at 150 revs. |
| 1898 | Duke of Cornwall | 325 6 | 37 0 | 16 6 | 12 0 | 2050 | 20.0 | 5,600 | 160.0 | Two 4-cylinder triple-expansion | 22½in., 34in., (2) 38½in. by 33in. | 4 S.E., 180 lb. | — 310 | |
| 1902 | Duke of Connaught | 315 0 | 38 0 | 17 6 | 11 9 | 2210 | 20.1 | 5,800 | 163.0 | Two 4-cylinder triple-expansion | 22½in., 34in., (2) 38½in. by 33in. | 4 S.E., 180 lb. | — 310 | |
| 1909 | Duke of Cumberland | 330 7 | 41 1 | 17 1 | 13 0 | — | 21.0 | — | 502.0 | 3-shaft turbine | — | 5 S.E. | — | Duke of Argyll, sister ship. |
| | G.W. Railway Co.— | | | | | | | | | | | | | |
| 1880 | Pembroke | 253 6 | 30 9 | 15 0 | 10 6 | 1250 | 16.0 | 2,500 | — | Compound oscillating | — | — | — | Afterwards converted to twin-screw engines. |
| 1889 | Lynx | 235 0 | 27 6 | 14 0 | 10 0 | 790 | 16.6 | 1,700 | 121.0 | Two 3-cylinder triple-expansion | 16½in., 26in., 41in. by 30in. | 2 S.E., 150 lb. | 3,800 118 | Antelope and Gazelle, sister ships. |
| 1891 | Ibex | 265 0 | 32 6 | 15 6 | — | 1270 | 19.3 | 4,200 | 152.0 | Two 3-cylinder triple-expansion | 22in., 34in., 51in. by 33in. | 2 D.E., 160 lb. | 9,140 250 | |
| 1897 | Roebuck | 280 0 | 34 6 | 16 6 | 12 6 | 1740 | 20.2 | 6,400 | 160.0 | Two 3-cylinder triple-expansion | 23in., 36in., 56in. by 33in. | 2 D.E., 175 lb. | 10,838 250 | Reindeer, sister ship. |
| 1906 | St. George | 351 0 | 41 0 | 16 0 | 13 3 | 2750 | 23.0 | * | 465.0 | 3-shaft turbine | K = 82 H.P. 48in. L.P. 68in. | 8 S.E. 180 lb. | 17,840 462 | St. Andrew, St. David, St. Patrick, sister ships. |
| 1902 | Great Western | 300 0 | 36 0 | — | 11 9 | 1780 | 16.2 | 2,920 | 156.0 | Two 4-cylinder triple-expansion | 19in., 29½in., (2) 33in. by 30in. | 2 D.E. 160 lb. | — | Great Southern, sister ship. |

* Not recorded on trial.

Garryowen, built by Laird Bros. at Birkenhead in 1833 and 1834 for the City of Dublin Steam Packet Company. They were 130ft. long, with engines of 90 horse-power nominal, and 148 and 263 tons B.M. respectively. Laird Bros. built a number of these early craft, including, in 1840, the first iron mail packet in H.M. service—the Dover, of 228 tons B.M.—for the Dover-Calais route. The Princess Clementine, Princess Helena and Lord Warden, 160ft. long and 446 tons B.M., were built for the South-Eastern Railway Company in 1846–7, and the St. Columba and Cambria, 190ft. long and 700 tons B.M., for H.M. Holyhead and Kingstown mail service, followed in 1847–8. The Manx Fairy and Ellan Vannin were built in 1853–4 for the Isle of Man service; they were 163ft. and 419 tons and 170ft. and 336 tons respectively. All these were paddle steamers. Similar craft were doubtless constructed by other builders for other services, but the first large and important vessels of this type were the Ulster, Munster and Connaught, built in 1860 at Birkenhead, and the Leinster, built by Samuda on the Thames. These four vessels were 334ft. long between perpendiculars by 35ft. wide. They ran their official trials on the measured mile in Stokes Bay, the Leinster obtaining 17.7 knots with 4200 indicated horse-power, and the Connaught 18.114 with 4700 indicated horse-power, the displacements being 1900 tons and the draught of water 12ft. 7in. These vessels were re-boilered some twenty-five years later and, in spite of running in service at about 2200 tons displacement, continued to develop 16.5 knots and kept that speed for many years afterwards. In fact, it was not until 1896–7, when they were replaced by four modern twin-screw vessels bearing the same names, that they were taken off the Irish mail service after thirty-five years' hard work.

The development on this route even in these early days was forming precedent. The London and North-Western Railway Company entered the field with the 300ft. Lily and Violet, built at Birkenhead in 1880. These vessels maintained 17 knots, having done 17.75 knots on trial with 3200 indicated horse-power and 28 revolutions. With only 33ft. beam and a displacement of 1450 tons, we see the commencement of the tendency towards high speed on the smaller dimensions. After running for about ten years both ships were re-engined and re-boilered, their oscillating engines being replaced with a remarkable design of triple-expansion steeple engine* with cylinders 44in., 70in. and 108in. diameter by 78in. stroke, and the box boilers by others of the locomotive type and forced draught. A distinct saving in weight was effected, while the power was increased to 4070 indicated horse-power, which gave 19.5 knots on the official trial with 35 revolutions; 3300 indicated horse-power gave 18.7 knots with 32½ revolutions. Another well-known vessel for the London and North-Western Railway Company, the Banshee, followed in 1884. She was 310ft. long and displaced 1600 tons, and there seems no doubt that on many occasions she exceeded 20 knots, developing about 4850 indicated horse-power. The City of Dublin Steam Packet Company met this competition of the London and North-Western Railway Company by re-boilering the four "Ulsters," and in 1885, with the famous Ireland,† of 2400 tons displacement and 360ft. long. Her engines were of the two-cylinder oscillating type with cylinders 102in. in diameter and stroke working with 30 lb. pressure. The paddle wheels were 33ft. 4in. diameter over the floats, which were 13ft. long by 5ft. 9in. wide. The Ireland also is credited with well over 20 knots and certainly developed more than 6000 indicated horse-power on occasions. The distinguishing feature, perhaps, of all these vessels from the Ulster onwards was the fine shape and narrow beam. Both block and prismatic coefficients were low compared with subsequent practice, and the ratio of length to displacement high, so that they were easily driven; but there seems to be no doubt that in both the Lily and Banshee very good propulsive efficiency was obtained. The Ireland was the last of the big Holyhead paddle boats, and two years afterwards the London and North-Western Company introduced twin screws in the Olga and thereby inaugurated a new era in design in this class of ship. The Ireland proved rather a white elephant in service; the immense cylinders caused a good deal of trunnion trouble, and after some mishaps she passed off the

* See THE ENGINEER, April 17th and August 7th, 1891.

† See THE ENGINEER, August 28th, 1885.

# THE DEVELOPMENT OF CHANNEL STEAMER DESIGN.

TABLE I. (*continued*).

| When built. | Name and owner. | Length. | Beam. | Depth. | Dr'ught. | Displacement. | Speed. | I.H.P. or S.H.P. | Revolutions. | Engines. Type. | Engines. Cylinder or rotor diameters. | Boilers. Number Pressure. | Boilers. H.S. G.S. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L. and S.W. Railway Co.— | ft. in. | ft. in. | ft. in. | ft. in. | Tons. | | | | | | | | |
| 1864 | Brittany | 216 0 | 25 6 | 13 1 | — | 529 | — | — | — | Two simple cylinder | (2) 60in. by 60in. | — | — | |
| 1881 | Ella | 236 0 | 29 1 | 14 3 | — | — | 14.0 | — | — | One 2-cylinder compound | 37in., 68in. by 39in. | 30 lb. | — | |
| 1900 | Alberta (Frederica, 1899) | 270 0 | 35 6 | 14 6 | 12 0 | 1900 | 19.0 | 4,500 | 194.0 | Two 4-cylinder triple-expansion | 19½in., 31½in., (2) 36½in. by 30in. | 80 lb. 2 D.E., 200 lb. | — 8,738 280 | 135 first, 50 second-class passengers. |
| 1910 | Sarnia | 284 0 | 39 0 | — | 12 3 | 2000 | 20.4 | 6,800 | 530 C. 520 W. | Three-shaft turbine | K = 98. H.P. 43in. L.P. 58in. | 2 D.E., 160 lb. | 12,985 338 | Cæsarea, sister ship, 136 first, 114 second-class passengers. |
| 1911 | Normannia | 290 0 | 36 0 | — | 12 3 | 1864 | 19.7 | 5,000 | 310 | Two-shaft geared turbine | K = 149. H.P. 14in.-23in. L.P. 39in. | 1 D.E., 1 S.E., | 10,221 303 | Turbine revolutions, H.P. 2000, L.P. 1400. Hautonia, sister ship. |
| | L. B. & S.C. Railway Co.— | | | | | | | | | | | | | |
| 1856 | Lyons | 189 2 | 21 8 | 9 10 | 6 0 | 269 | — | — | — | Two simple cylinder | (2) 52in. by 54in. | — | — | |
| 1882 | Brittany | 231 0 | 27 7 | 10 7 | — | — | 16.5 | — | — | Compound | 46in., 83in. by 60in. | — 110 lb. | — — | |
| 1896 | Sussex | 275 0 | 34 0 | 14 6 | 8 11½ | 1213 | 20.4 | 4,770 | — | — | — | 4 S.E., 160 lb. | 11,673 250 | $\frac{V}{\sqrt{L}} = 1.23.$ |
| 1900 | Arundel | 276 10 | 34 0 | 14 6 | 9 4 | 1296 | 20.69 | 5,520 | 200 | Two 4-cylinder triple-expansion | 23½in., 35½in., (2) 37½in. by 27in. | 2 D.E., 160 lb. | 9,200 290 | ,, 1.245. |
| 1903 | Brighton | 276 10 | 34 0 | 14 6 | 9 2½ | 1252 | 21.36 | * | — | 3-shaft turbine | — | 4 D.E., 150 lb. | 9,131 300 | ,, 1.283. |
| 1905 | Dieppe | 282 0 | 34 8 | 13 10 | 9 3 | 1215 | 21.76 | * | 610 C. 630 W. | 3-shaft turbine | K = 82. H.P. = 33in. L.P. = 45in. | — — | 9,630 294 | ,, 1.295. |
| 1911 | Newhaven | 292 0 | 34 7 | — | 9 8 | 1520 | 23.9 | 13,000 | 670 | 3-shaft turbine | — | Belleville | 21,377 645 | ,, 1.4. |
| 1912 | Rouen | 292 0 | 34 7 | — | 9 7 | 1485 | 24.06 | — | — | 3-shaft turbine | — | Belleville | 21,377 645 | ,, 1.41. |
| 1913 | Paris 301-9o.a. | 293 6 | 35 6 | 15 2 | 9 0½ | 1510 | 25.07 | 14,000 | 435 | 2-shaft geared turbine | — | 8 Yarrow | 24,040 588 | ,, 1.447. Turbine revolutions, H.P. 2610, L.P. 1849. |
| 1921 | Versailles 303-6o.a. | | 36 2 | 15 10 | 9 6 | 1630 | 24.6 | 15,000 | 371.3 | 2-shaft geared turbine | — | 8 Belleville, 256 lb. | — — | ,, 1.413. Certified to carry 1200 passengers. |
| | S.E. and C. Railway Co. | | | | | | | | | | | | | |
| 1840 | Dover | 113 0 | 21 0 | 9 10 | — | 228 | — | 90 | — | Paddle | — | — | — | H.M. mail packet. |
| 1846 | Lord Warden | 160 0 | 24 0 | 10 9 | — | 446 | — | 160 | — | Paddle | — | — | — | |
| 1861 | Victoria | 208 6 | 24 0 | 11 6 | 6 0 | 374 | 10.0 | — | — | Paddle | (2) 58in. by 54in. | 30 lb. | — | |
| 1882 | Invicta | 312 0 | 33 6 | 16 0 | 8 6 | — | 17.5 | 4,000 | 33.8 | Paddle | (2) 80in. by 78in. | 4 Box, 34 lb. | 14,300 604 | |
| 1893 | Calais-Douvres | 324 0 | 36 0 | 14 0 | 9 0 | 1660 | 20.6 | 6,000 | 49.0 | Paddle | (2) 59in., 106in. by 72in. | 4 D.R. | 13,874 574 | |
| 1898 | Le Nord | 338 0 | 34 10 | 16 3 | 9 0 | 1750 | 21.5 | 7,000 | 52.0 | 3-cylinder triple | 42in., 59in., 86.6in. by 88.6in. | W.T. | 16,146 516 | |
| 1899 | Mabel Grace | 300 0 | 36 0 | 15 3 | 9 10 | 1480 | 19.75 | 5,800 | 46.5 | 3-cylinder compound | 77½in., 55in., 77½in. by 72in. | 6 S.E., 120 lb. | 12,660 360 | |
| 1903 | Queen | 323 0 | 43 0 | 15 8 | — | — | 21.73 | * | 600 | 3-shaft turbines | — | — | — | Onward and Invicta followed with 324 by 42.2, 9000 H.P., 22.2 kts. |
| | Empress | 311 3 | 40 1 | 15 8 | — | — | 22.5 | — | 650 | 3-shaft turbines | — | — | — | Victoria, sister ship, service speed 21.27. |
| 1911 | Engadine | 316 0 | 41 0 | 15 8 | — | — | 22.36 | — | — | 3-shaft turbines | — | 6 B. and W. | — | Riviera, sister ship, service speed 21.87, and service. |
| 1918 | Maid of Orleans | 341 0 | 42 0 | 16 0 | — | — | — | — | — | 2-shaft geared turbines | — | B. and W. | — | Biarritz, sister ship. |
| | Belgian State Railways— | | | | | | | | | | | | | |
| 1893 | Marie Henriette | 340 0 | 38 0 | 14 2 | 9 3 | 1847 | 22.2 | 8,130 | 53.0 | Paddle | 60in., 108in. by 84in. | 6 Admiralty, 120 lb. | 14,100 465 | Leopold II., sister ship, 1893. Average voyage 3 h. 40 min. in 1905, when turbines were introduced. |
| 1896 | Princesse Clementine | 340 0 | 38 0 | 14 2 | 9 4 | 1853 | 22.18 | 8,100 | 52.0 | Paddle 2-cylinder compound | 60in., 108in. by 84in. | 6 Admiralty, 120 lb. | 14,100 465 | |
| 1905 | Princesse Elisabeth | 344 0 | 40 0 | 15 0 | 9 7½ | 2005 | 24.0 | * | 490 | 3-shaft turbines | K = 90. H.P. 48in. L.P. 68in. | 8 S.E., 150 lb. | 19,800 485 | Jan Breydel and Peter Coninck, sister ships, 1910. Average voyage 3 hrs. |
| 1913 | Stad Antwerpen | 360 0 | 36 0 | 22 9 | 9 3 | — | 24.1 | * | — | 3-shaft turbines | — | 6 B. and W. | — | Ville de Liége sister ship, 1914. |
| | Royal Dutch S.S. Co.— | | | | | | | | | | | | | |
| 1877 | Princesse Marie | 280 0 | 35 0 | 16 6 | 12 0 | — | 17.0 | — | — | 2-cylinder compound | 60in., 104in. by 84in. | — | — | |
| 1895 | Koningin Regentes | 320 0 | 35 8 | 16 0 | 12 0 | — | 21.2 | 9,000 | — | 3-cylinder triple | 51in., 75in., 112in. by 78in. | — | — | |
| 1909 | Oranje Nassau | 350 0 | 42 7 | 16 4 | 12 7 | — | — | — | — | Two 4-cylinder triple-expansion | 28in., 43½in., (2) 49in. by 33in | 4 D.E., 190 lb. | 19,450 534 | |
| 1919 | Oranje Nassau | 350 0 | 42 7 | 16 4 | 12 7 | — | — | — | — | Two 4-cylinder triple-expansion | 28in., 43½in., (2) 49in. by 33in. | 4 D.E., 190 lb. | 19,450 534 | |
| | G.E. Railway Co.— | | | | | | | | | | | | | |
| 1883 | Norwich | 260 0 | 31 4 | 15 1 | 14 0 | — | 14.0 | 2,000 | — | Two 2-cylinder compound | 30in., 57in. by 36in. | — 90 lb. | — — | |
| 1897 | Dresden | 302 0 | 38 0 | 16 3 | 14 0 | 2400 | 18.5 | 5,450 | 134.0 | Two 3-cylinder triple-expansion | 26in., 39½in., 63in. by 36in. | 5 S.E., 160 lb. | 11,500 357 | Vienna, sister ship, now Roulers, built in 1894. |
| 1908 | St. Denis | 331 0 | 43 2 | 17 8 | 15 6 | — | 20.5 | — | 450 | 3-shaft turbine | K = 84. H.P. 95in. L.P. 63in. | 5 S.E., 1 Aux., 160 lb. | — — | Was Munich. Copenhagen, sister ship. |
| 1920 | Antwerp | 321 6 | 43 1 | 17 0 | 15 6 | — | — | — | — | 2-shaft geared turbines | — | 5 S.E., 1 Aux., 200 lb. | 14,731 434 | Bruges, sister ship. |
| 1921 | Malines | 320 7 | 43 2 | 18 0 | 13 3 | 2800 | 21.5 | 11,100 | — | 2-shaft geared turbines | — | 5 S.E., 200 lb. | — | Displ. with 170 tons D.W. |
| | G. J. Burns— | | | | | | | | | | | | | |
| 1905 | Viper | 315 0 | 39 6 | 15 7 | 14 3 | 2435 | 22.0 | 8,500 | 600.0 | 3-shaft turbine | K = 94. H.P. 33in. L.P. 45in. | 4 D.E., 165 lb. | 16,020 501 | Now Snaefell on I.O.M. S.P. Co.'s service. |

* Not recorded on trial.

Holyhead service after about twelve years' work.

Paddle steamers, however, continued to be built for other lines for many years afterwards, the last British vessels of this type being the Princess of Wales and Mabel Grace, built for the South-Eastern Railway Company's service in 1897 and 1899 respectively. Restricted draught of water in the French ports was the reason for their retention. The last French packet with wheels was Le Nord, built in 1898. The former were fitted with compound engines, but Le Nord had a diagonal triple-expansion engine of 7000 indicated horse-power, which gave her over 21 knots on trial. On account of the depth of water, both the Belgian State Railways and the Royal Dutch Company adhered to paddles. The former built some very fast vessels of over 22 knots trial speed with compound engines. The Koningin Regentes, of the latter line, was fitted with a triple engine of 9000 indicated horse-power, the cylinders being 51in., 75in. and 112in. diameter by 78in. stroke; this was one of the largest paddle engines ever constructed. Actually the largest was of over 11,000 indicated horse-power. It was the three-cylinder compound engine fitted in the Empress Queen of the Isle of Man Steam Packet Company's Liverpool-Douglas service. The Empress Queen was the last of the big paddle steamers built in Great Britain. She was the same length as the Ireland, but 4ft. wider and 9in. less draught. Of 2900 tons displacement, she was remarkable as an excursion steamer, often carrying over 2000 passengers and easily maintaining 20 knots in service. The Isle of Man Company's older paddle vessels were also fine ships, the Mona's Isle, built in 1882, having a long and successful record. These vessels, however, were mainly used for the summer excursion traffic, a fact always to be remembered when considering their length of service. The heavy weight of the paddle-wheel machinery eventually told against it, and though both the Great Eastern Railway and the London and North-Western Railway Company had previously adopted them, the introduction of twin screws began in earnest about 1890, when the Great Western Railway Company built the Lynx, Antelope and Gazelle, followed in 1891 by the larger Ibex, for its Weymouth to Guernsey service. These vessels were the forerunners of the very numerous twin-screw designs that were adopted on all routes except the Calais, Ostende and Flushing services until the advent of the steam turbine.

Table I. gives a chronological list of Channel steamers running from the West Coast ports; we shall deal with the Southern and Eastern services in a future issue. Many of the vessels in this list had long and serviceable war records. Both the Connaught and the Leinster, of the City of Dublin Steam Packet Company, were sunk, the latter when carrying passengers on her usual route. The Ireland passed into the shipbreaker's hands twenty years ago. The 1900 "Anglia" class proved invaluable for transport work; only two now survive, the Cambria and Scotia, as the Arvonia and Minevia, the names being changed with the advent of the 1920 "Anglia" class. Both the Viking and the Ben-My-Chree—the latter the largest and most powerful of all until the new "Anglias" appeared—were converted into seaplane carriers and did much useful work. Ben-My-Chree was lent to the French for an operation on the coast of Asia Minor and was sunk by gun fire from a Turkish fort. The King Orry was attached to the Grand Fleet and was given a prominent position at the surrender of the German Navy. All four of the "St. George" class were converted into hospital ships and used for bringing wounded from France. Either as hospital ships or local scouts, or as mine-sweepers, if their draught was small, the British Channel steamers, in addition to their ordinary transport work, which those employed on it found exceptionally heavy, rendered sterling service to the country.

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THE United Provinces Board of Industries has recommended that the Indian Government should guarantee interest at the rate of 7 per cent. for five years to the organisers of the Kosi Valley Hydro Electric Scheme in order to enable them to produce power to work a textile mill near Almora. The Andhra Valley Power Supply Company has commenced supplying power to Bombay mills to the extent of 2000 horse-power. The supply will be increased as mills are adapted to electrical drive. Motors and other electrical appliances necessary for adapting machinery to electrical drive in the Bombay mills are in demand.

## Double-Range Scherbius Rolling Mills.

PRACTICALLY all merchant and bar mills are required to roll a large variety of products. Even those designed for a large tonnage are called upon to handle weights which vary in the ratio of 10 to 1, whilst ordinary mills are required greatly to exceed that weight ratio. Combined with this factor, the fairly definite speed which each particular product calls for and at which the mill will roll the maximum tonnage necessitates the use of an adjustable-speed mill motor, and in addition to the usual characteristics which such motors must possess, it is essential that when the machine has been adjusted for any particular speed throughout the range of control, this speed must only be slightly affected by wide variations in load. The motor should, moreover, be capable of carrying heavy overloads throughout the whole range of speed, and the efficiency of the machine should be at its highest value whilst working on the particular range of speed required for the maximum period of production. It is also essential that the power factor should be high, and that the cost of the motor should not be excessive.

It was only natural to find a few years ago mill engineers making every effort to adapt mills to induction motor characteristics. Where the range of sections to be handled required different speeds, two or three compromise speeds were chosen and multi-speed motors were purchased, but even at their best these motors are inflexible and their use always entails a sacrifice, especially when 25-cycle current is used, and it is difficult to obtain speeds which are sufficiently near to those which are desired. Appreciation of these facts has led many leading engineers in Europe and America to devote attention to the study of the problems which are involved in the design of alternating-current motors which would embody the mechanical characteristics of the induction machine with the speed characteristics of the adjustable-speed direct-current motor and at the same time have an efficiency approaching that of the multi-speed induction motor. Many schemes have been suggested, but most of them have passed into history with only a Patent Office record.

The system most widely used at the present time to fulfil the above-mentioned conditions is the Scherbius system, which has been adopted by the General Electric Company of America, and which has been found to meet all the requirements of rolling mill drives. With this system the speed of the driving induction motor may be varied over a wide range, and when set to any desired value it will remain practically constant independently of the load. Equipments may be designed to meet any variations of speed with load. They may be made to give constant torque, constant horse-power, or any variation of these factors, and the speed may be easily and quickly adjusted without in any way affecting the overload capacity or any other of the desirable characteristics of the main driving motor.

As an example of an installation of this type and the first of the kind in Europe, the electrical equipment of the new 12in. merchant and 10in. strip mills at the Templeborough Works of United Strip and Bar Mills, Limited, is of exceptional interest. The system employed in this case is known as the double-range modified Scherbius system, which permits of speed control of the main motor, below, at, or above synchronism up to such limits as are determined by the capacity of the regulating machine. Provision is also made for adjusting the power factor under the various load and speed conditions, and the system is claimed to constitute the most efficient scheme that has so far been devised for induction motors. The electrical equipment for these mills, which was supplied by the British Thomson-Houston Company, of Rugby, consists of a main mill motor and regulating set for the 12in. merchant mill and three motors and two regulating sets for the 10in. strip mill, the roughing and finishing mills being equipped with induction motors and the intermediate edging mills being driven by a direct-current variable-speed motor.

A view of the merchant mill motor-house, showing the main motor and regulating set, with controllers and speed-indicator pedestal in the foreground, is shown in Fig. 9 on page 526, whilst Fig. 11 on the same page gives another view of the merchant mill motor-house, and also shows the regulating set and contactor gear. A view of the back of the contactor panels and the ohmic drop exciter, which will be described later, is shown in Fig. 1, whilst Fig. 2 shows the extra high tension cellular switchgear with control panels and the extra high tension reversing contactors. The interior of the strip mill motor-house, which contains the roughing and finishing mill motors, contactor panels and regulating machines for the roughing and finishing mills, is shown in Fig. 12 on page 526, whilst Fig. 10 gives a view of the strip mill motor-house showing the roughing mill motor and operating platform for controlling the complete mill, the direct-current motor for the intermediate edging rolls being shown on the left of the picture. The strip mill extra high-tension cellular switchgear, with 6300-volt operating panels, is shown in Fig. 3. Details of the various motors and regulating sets are given below.

12in. merchant mill: Induction motor, 3000/3000/3000 horse-power, running at 470/375/280 revolutions per minute; regulating set, 950 kilowatts, at a speed of 375 revolutions per minute; alternating-current commutating machine; and 775 horse-power induction motor.

10in. strip roughing mill: Induction motor, 1500/1150/805 horse-power at 325/250 175 revolutions per minute; regulating set, 310 kilowatts at a speed of 750 revolutions per minute; alternating-current commutating machine; and a 420 horse-power induction motor.

Intermediate edging rolls: Direct-current 230-volt variable-speed motor, 50/100 horse-power at 240/600 revolutions per minute.

10in. strip finishing mill: Induction motor, 2500/2080/1670 horse-power at speeds of 240/200/160 revolutions per minute; regulating set, 750 revolutions per minute; 375-kilowatt alternating-current

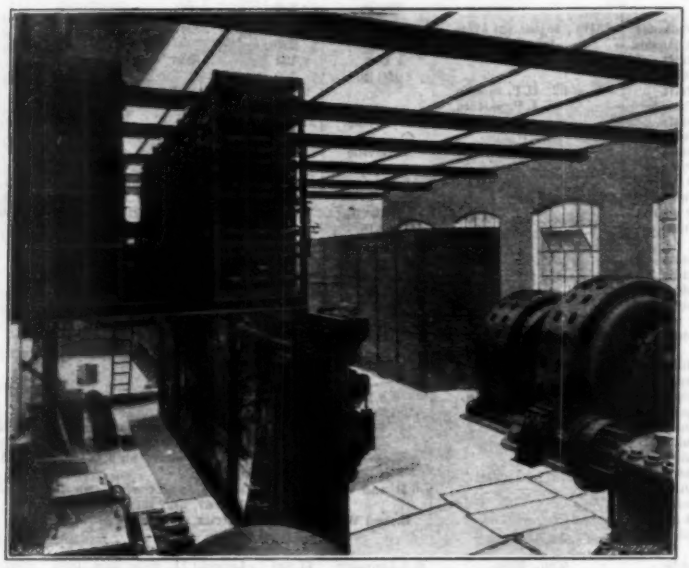

FIG. 1—BACK OF CONTACTOR PANELS FOR MERCHANT MILL

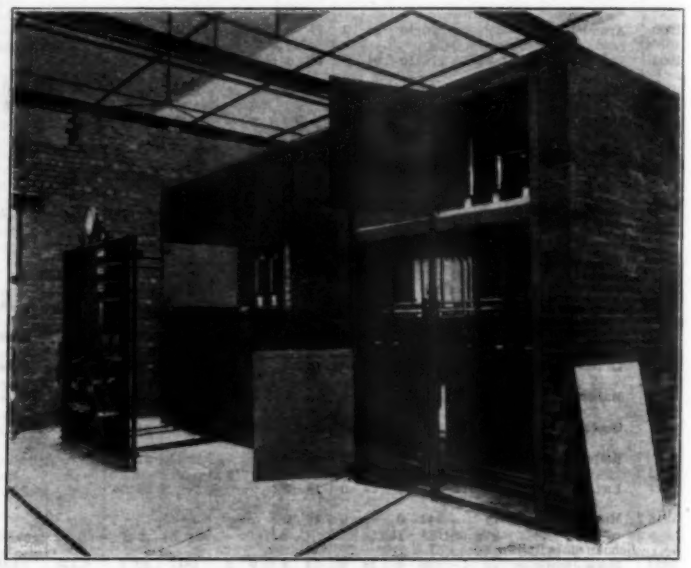

FIG. 2—MERCHANT MILL, EXTRA-HIGH TENSION SWITCH GEAR

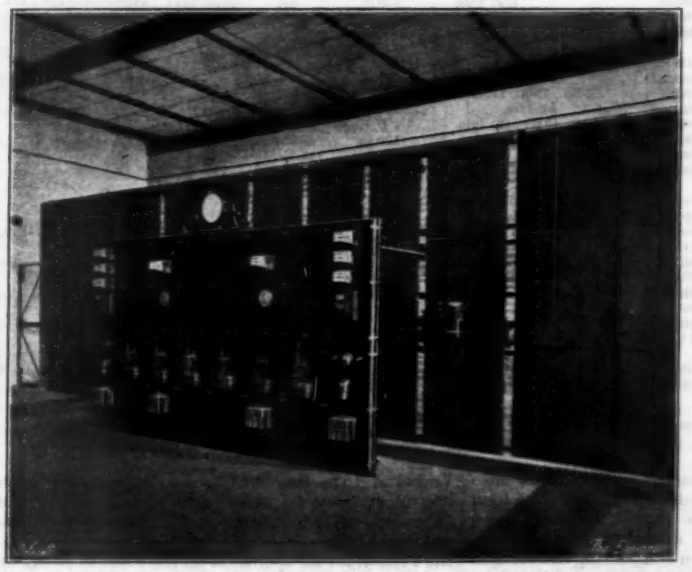

FIG. 3—STRIP MILL, CELLULAR SWITCH GEAR

FIG. 4—GENERAL VIEW OF MERCHANT MILL, SHOWING COOLING BEDS

commutating machine; and 510 horse-power induction motor.

The main mill alternating-current motors are of the usual three-phase induction type with polyphase-wound rotors, the stator windings constituting the primary and the rotor windings the secondary. As is well known, when voltage is applied to the primary windings, the alternating currents in the various coils produce a magnetic field which revolves at a speed depending on the frequency, and inversely on the number of poles. In the secondary windings, which are cut by this rotating field, a voltage is generated, and this voltage is at its maximum value when the rotor is stationary, and under these circumstances the frequency of the secondary circuit is exactly the same as that of the primary circuit. The currents which flow in the secondary windings exert a torque which causes the rotor to turn in the direction of the rotating field and at a speed which only increases with a corresponding decrease in the voltage and frequency of the secondary circuit. The rotor speed will increase until a definite number of revolutions is reached, when the voltage is only just sufficient to send the requisite amount of current through the impedance of the windings to develop the required torque. If the load remains constant under normal conditions and the speed is reduced by the usual method of inserting resistance in the rotor circuit, then at any definite speed the voltage and frequency are practically proportional to the slip which is specified as a percentage of the synchronous speed.

If, however, instead of employing an external resistance a constant voltage at rotor frequency is used to oppose the secondary voltage, the speed of the rotor will adjust itself to such a value that the secondary voltage will exceed the opposing voltage only by an amount which is equal to that which is necessary to send sufficient current through the impedance of the circuit to develop the required torque, and if the opposing voltage is made adjustable the speed of the main motor may be changed by the simple operation of varying the value of the opposing voltage. The function of the regulating set is to provide a variable source of voltage which can be adjusted at will and which may be imposed upon the secondary windings of the main motor, and in this manner it is possible to adjust the speed of the main motor in an economical manner either above or below the synchronous or free-running speed, and independently of the load. With normal sources of field excitation, but with the power leads disconnected, and when the machine is running at constant speed, the induced voltage of this regulating machine will remain constant; but in the case of the mill motor the induced voltage and frequency will vary proportionately with the departure from synchronous speed. If, under the above circumstances, the terminals of the regulating motor are connected to the slip rings of the main motor, any difference between the induced voltage of the two machines would result in the circulation of a current through the rotor windings of the main motor, and this current would produce a torque which in turn would adjust the speed of the main motor to a value corresponding with that at which the induced voltages of the two mach inesare equal. The speed of the main motor will vary slightly with the torque. The greater the torque demanded by the mill, the greater is the departure from synchronous speed or the speed at which the induced voltages of the two machines are equal, this variation in speed being similar to that of a normal induction motor with short-circuited slip rings.

The regulating machine consists of a completely compensated shunt-wound three-phase alternating-current commutating motor fitted with interpoles and directly coupled to a squirrel-cage induction motor. The function of the squirrel-cage motor is to maintain a practically constant speed for the regulating machine, and when the mill motor is running above synchronous speed it acts as a motor and draws its current from the line, whilst when the mill motor is running below synchronism it is driven as a generator and returns power to the line. When the squirrel-cage machine is acting as a motor under the above conditions, the regulating machine is driven as a generator and supplies power to the slip rings of the mill motor, whilst when the squirrel-cage machine acts as a generator the regulating machine operates as a motor and draws its power from the slip

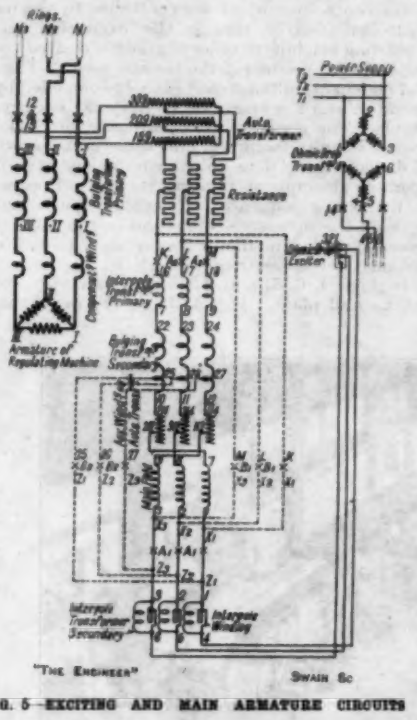


FIG. 5—EXCITING AND MAIN ARMATURE CIRCUITS

rings of the mill motor. The regulating machine will operate with either phase rotation, and also with direct current. Separate excitation at the exact slip ring frequency and phase rotation at all times is provided by a commutator frequency changer, which is called the ohmic drop exciter. This exciter is capable of giving a constant voltage with varying frequency, and the frequency is always the same as that of the secondary circuit of the mill motor. The armature of this exciter, which is mounted on the mill motor shaft, resembles the armature of a rotary converter, for it has a commutator and slip rings.

The field punchings which surround the armature are devoid of slots and windings, and the commutator, which is usually designed to deal with three-phase current, is generally provided with a multiple of three sets of brushes. The slip rings of the exciter are connected to the main power lines through a transformer which is designed to give a suitable voltage for exciting the regulating machine. If, for example, the armature of the exciter is at rest, when the voltage is applied to the slip rings, the alternating currents in the various coils produce a magnetic field which will revolve round the rotor at a speed depending directly upon the frequency and inversely on the number of poles, as in the case of an ordinary induction motor. If, however, the armature of the exciter be rotated at synchronous speed, and if the direction of rotation of the magnetic field be opposite to that of the mechanical rotation of the armature, then the magnetic field would no longer rotate in respect of the stator, but would virtually stand still in space. Under these circumstances, the armature conductors, revolving at synchronous speed, would cut this stationary field, and a voltage would be generated which would deliver direct current from the brushes on the commutator exactly as in the case of a direct-current generator. At one-half synchronous speed the magnetic field would be rotating at half speed in one direction, and the armature at half speed in the opposite direction, with the result that the armature conductors would still cut the flux at the same rate as that of the previous example, and the voltage generated would therefore be the same as that at synchronous speed or when the armature is stationary. Instead of being at zero at synchronous speed, the frequency would be one-half of the normal frequency applied to the slip rings of the ohmic drop exciter, or, in other words, exactly the same as the frequency of the mill motor, for, as stated above, the magnetic field of the exciter rotates in space at one-half of the synchronous speed. At speeds differing from those mentioned the voltage generated is similarly constant and the alternating current is delivered from the brushes at a frequency equal to the slip frequency of the mill motor. Alternating current at zero frequency naturally becomes direct current. If the armature is driven at a speed above the synchronous value the magnetic field will rotate in the opposite direction, and the machine will deliver alternating current with the phase rotation reversed in comparison with that obtained when operating below synchronism.

When operating at any speed other than the synchronous speed, alternating current will be supplied to the field windings of the regulating machine, and the inductance of the field windings will then preponderate over the resistance. As the synchronous speed is approached the excitation supply from the main motor slip rings is gradually decreased until at synchronism it reaches the zero value. When near to or at synchronism the ohmic drop exciter is brought into service for excitation purposes, and at synchronous speed direct current is supplied to the machine. During such periods the regulating machine has a resistance which preponderates over the inductance, and the value of the exciting current can be adjusted by altering the amount of resistance in series with the ohmic drop exciter.

In addition to the machines described, there is a field control exciting transformer, an interpole transformer for use with the regulating set, an extra high-tension transformer for use with the ohmic drop exciter, a bulging transformer for use with the regulating set, a main contactor equipment with resistance for starting the main motor, and with the necessary contactors for connecting the regulating machine and ohmic drop exciter in circuit when required, and a field control contactor equipment for use with the field control exciting transformer for obtaining the various speed points. A fine speed regulation can be obtained, there being as many as thirty-one speed points in the case of the finishing mill and seventeen points each for the roughing and merchant mills. The equipment includes field reversing contactors, the necessary master controllers, interlocking contactors, selector switches, push buttons, &c. There is also the necessary extra high tension switchgear with auxiliary transformers. A diagram is given in Fig. 5 which shows the excitation circuits and main armature circuits of the regulating machine, and also the connections

FIG. 6—GENERAL VIEW OF MERCHANT MILL STANDS

FIG. 7—STRIP MILL ROUGHING AND FINISHING STANDS

to the ohmic drop exciter and its transformer for the 3000 horse-power motor for the merchant mill. For speeds above synchronism contactors $A_1$ and $A_2$ close, whilst for speeds below synchronism the contactors $B_1$ and $B_2$ are closed. Mechanical interlocks are provided between $A_1$, $B_1$ and $A_2$, $B_2$. The function of the interpole transformer is to correct the excitation for the interpole windings on the regulating motor, so as to keep the magnitude and phase relation correct at all loads throughout the regulating range, whilst the object of the bulging transformer is to improve the power factor of the main machine when running on load. Above synchronism it provides a compensating voltage of the correct phase and magnitude to overcome the inherent inductive voltage drop in the regulating machine, which would otherwise lower the power factor.

It will be gathered that the main circuits are controlled entirely by contactor gear, which is operated by master controllers, and this equipment, which may be reversed for stopping quickly in the case of emergency, includes, in addition to the necessary starting and speed-regulating points, a plug point, which is under the control of a special relay. The extra high tension switchgear and transformers are housed in brick cells, and are controlled from a switchboard mounted in front. The main motors are of exceptionally heavy and rigid construction, and the stator can be adjusted both vertically and horizontally so as an ordinary induction motor. If, however, the switch is set in the regulating position when the main induction motor is up to speed, the motor is automatically connected to the armature of the regulating machine, but this connection cannot be made unless there is no excitation on the regulating machine. If the operator desires to run the main motor above synchronism it is simply necessary for him to move the regulating controller one point at a time in the desired direction, whilst if, on the other hand, he desires to run the motor below synchronism, the same master controller is moved in the opposite direction.

The contactors, which are controlled by the master controller, merely change the excitation on the regulating machine in order to give the desired voltage variation for producing the desired speed. The strip and merchant mills are each entirely controlled by one operator, and the operation of the mills is extremely simple. The apparatus is electrically interlocked so that it is quite foolproof, and there is no possibility of damage being done to the equipment, even if the operator attempts to perform the control operations in the wrong sequence. Emergency push buttons, both on the operator's table and in the mills themselves, enable the main motor to be shut down instantly whenever required.

In Figs. 4, 6, 7, and 8 we give four views of the rolling mill plant. Fig. 4 shows the merchant mill

FIG. 8—GENERAL VIEW OF STRIP MILL

that the air gap may be adjusted and the stator may be moved in order to facilitate repairs.

The master controllers of the strip mill are arranged so that the operator can control the three mills, namely, the roughing, intermediate and finishing mills, from a single pulpit which is situated in full view of the loop between the roughing and finishing stands, and the operator can therefore control the length of the loop as required, and is also in a position to shut down the mill in the case of emergency in the shortest possible time.

The contactor panels for starting the main induction motors of both the roughing and finishing mills consist of a number of starting contactor switches which control grid resistances which are inserted in the rotor circuits of each machine during the starting period, and the closing of these contactor switches is under the control of the current limit relays. If he so desires, the operator can start up the mill motor slowly by advancing the master controller one point at a time, but if the controller is thrown hard over the contactor switches will only close at a predetermined rate, and the amount of current drawn from the line is regulated within definite limits by the current relays. The speed control panels which have been provided for the two main motors differ somewhat in arrangement. That for the finishing mill is provided with a manually operated master controller for giving the desired speed changes, whereas the speed of the roughing mill motor is governed by a remote control master controller, and all the operator has to do is to move a small pilot switch into the required direction, and this simple operation actuates the motor-driven controller, which is arranged so that it must move over a complete step even if the operator releases the pilot switch before the controller has time to complete the full movement to the next notch. Indicating lamps are provided to show the position of the motor-driven controller, when raising and lowering the speed, and also for indicating whether the controller has completed its movement to a running notch. The control of the merchant mill is similar to that of the strip mill finishing stand motor. In the case of both the strip and merchant mills, a transfer switch situated on each of the starting panels enables the operator to set the main motor control gear for regulating or non-regulating running. If the switch is set in the non-regulating position, the last of the series of rotor contacts is arranged to short-circuit the rotor when the machine is up to speed, and it then runs and cooling beds, Fig. 6 gives a general view of the merchant mill stands, Fig. 7 a general view of the strip mill, showing the roughing and finishing stands, and Fig. 8 a general view of the strip mill.

## The Influence of Mobile Batches on Manufacturing Capital.

By A. WHITEHEAD.

In repetition work as usually carried on, with a large proportion of the machines running first on one job and then another, the non-productive time in breaking down and re-setting tools at each change is considerable. The longer each run and the less frequent the changes, the more nearly mass production is approached. But in the majority of engineering machine shops, excluding those which are not specially laid out and equipped for doing standardised work economically, there are still more different operations to be done than machines to do them on. Consequently it is usual to find the bulk of the machines used as required by the flow of work and set up in continually changing ways accordingly. The remaining machines may be allocated to unvarying production and change their set-ups rarely. In several ways this last is the simplest to manage, but it is unusual—except in certain special manufactures concerned with but a small variety of different parts—for the output desired to be large enough to make it feasible to restrict many machines permanently to individual operations in this manner. In this article we will consider the general case, examining some effects of varying the frequency of changing jobs on a machine and a few different ways of arranging the flow of work.

It being obvious that the fewer the changes the less the time lost in re-setting, it is common for production orders—or convenient subdivisions of them—to fix the quantities of work which should be done at each set-up. A popular method of effecting this may be termed the intact batch system to distinguish it from the method here contrasted with it. The theory of the intact batch is that all the parts belonging to it must travel together. This method has several good qualities; it is convenient for paying piecework or premium bonus wages; the accounting for and tracing of work in course of production by the progress department is simple. The quantity to be done with one setting of a machine cannot be below that in one batch, and therefore the time spent in changing jobs is to some extent under control. When the quantities are very small or the operations very quick, so that the total time taken for the longest operation to complete the whole batch is short, the intact batch system is quite satisfactory. It may be varied slightly, so that when the successive operations follow on neighbouring machines they may be treated to some extent as one operation as far as progress records and transport are concerned. But this variation cannot apply in a wholesale manner, nor when an operation done on one machine is followed by another which must be done in a place far enough removed to make transport a definite process rather than a hand-to-hand move. In fact, any departure from the rigid system is more a temporary expedient for a special purpose than a real alternative which can be extensively used. The size of the batches is carefully fixed when production orders are issued according to what experience has proved to be desirable. But the system is always arranged so that a special sub-production order can be issued to pick up a batch at any stage in its progress, and subdivide it into smaller quantities if desired. One minor advantage of this system is that the production order itself can accompany the work in its travels, thus saving special tickets or tags for identifying it; and it can also specify the sequence of the operations so that the next stage in the production of the batch is shown very simply to those responsible for transport as soon as they refer to the order.

But, despite these good qualities, the intact batch system is unsuited to repetition work when the quantities are large. Of course, large and small are relative terms. For our purpose we shall consider it a small quantity, or a small batch, when the whole lot would pass through the longest operation in less than ten hours. It will be noted that a time is given, not a quantity of parts, it being immaterial whether 5 or 5000 parts are concerned. If a batch of 5000 passes its longest operation in ten hours—this is an arbitrary, but suitable limit—it is for the present purpose a small batch; but 5 would constitute a large batch if the longest operation occupied more than two hours on each part. It is clear, therefore, that if, as an example, 100 machines of one type and size were ordered at the rate of, say, ten a week, the various parts comprised in the machines could be ordered in batches of ten sets, so as to cover requirements week by week. But this probably would make what, by our standard, are some large and some small batches in each set of weekly orders. Unless the system in vogue applies equally well to batches of all sizes, there are certain to be losses through its want of elasticity.

The great defects of the intact batch system are:—

(1) The quantity of material in constant circulation in order for a given output to be regularly maintained is comparatively large and therefore locks up more capital than the dispersed batch system.

(2) The rate that material advances from stage to stage of production is slow, and it is consequently difficult to force special work through quickly without breaking the system in spirit.

It should be clear that capital is not only laid out in materials in course of production, but floor space has to be increased to accommodate them, buildings have to be larger, transport is slightly increased, and other incidental expenses are heavier; also it is not desirable to lose orders for machines differing only very slightly from the standard design merely because an inelastic system forbids quick delivery. So if some modification of the rigidly intact batch system can be used which will not have these defects, and yet be as good in other respects, there is a distinct gain. Or there are alternative ways of controlling the movement of work in the shops which have merit.

It is convenient to have a definite subject in view while examining the working of a system, and that is why the machine shop was specifically mentioned earlier. To any form of repetition work similar considerations apply, whether it be machine or hand work of any kind. Let us choose to consider the effects of four modes of dealing with a batch of parts which has to pass through seven operations on machines. The quantity in the batch is immaterial, but the times required to complete each operation on the whole lot under normal conditions are, let us say, as given in the following table:—

| Operation. | Production time. | Setting time. |
|---|---|---|
| 1 | 20 | ¼ |
| 2 | 120 | 3 |
| 3 | 65 | 1 |
| 4 | 96 | 2 |
| 5 | 30 | ½ |
| 6 | 84 | ½ |
| 7 | 20 | ½ |

This is a typical sequence with long and short operations alternating. The setting times are for making one set-up only. The total production time is 435 hours and setting time eight hours. When one operation is finished there is usually some delay before its successor commences for inspection, transport and booking. We shall assume that this delay amounts to ten hours in every case. Therefore, with the intact batch system, there is an interval of ten hours between finishing the last part in one operation and commencing the first at the next. With the

dispersed batch method, which we shall contrast with it, the ten hours' interval still applies; but it is not necessarily apparent at the end of any operation, although provided at its commencement.

In Fig. 1 the first method represents the progress, in time, of the intact batch. From the commencement of the first operation to the end of the last is nearly 500 hours. We have as much control over the batch as if it consisted of one piece in many ways, but it too closely resembles the flow of a glacier to be satisfactory entirely. Now let us suppose that the quantity in the batch amounts to three weeks' output requirements. It would be convenient to split the batch into three equal portions as shown in method 2. Worked with intact but smaller batches, the speed through the shops is accelerated. As shown, the time to pass through the seven operations is reduced to

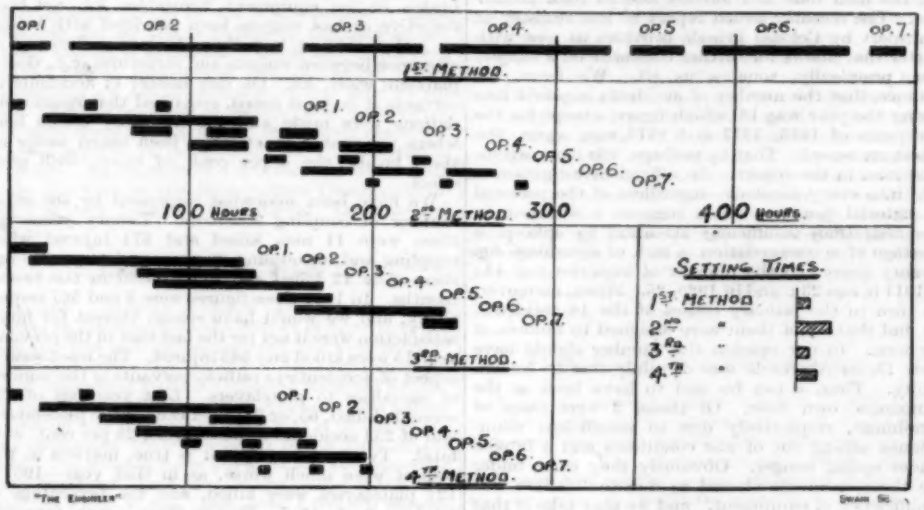


FIG. 1—INTACT AND DISPERSED BATCH METHODS OF PRODUCTION

200 hours. But we have to pay for it in extra setting time. It will be noted that operation 2 is made continuous to keep the loss as small as possible, but still it amounts to eighteen hours instead of eight. In operations 4 and 6 the breaks between successive batches are so small that it would be probably inconvenient to introduce other jobs in them. The tendency would be to depart from the regularity shown, to have eighteen hours' setting and considerably more than 200 hours' passage time, because the nominal ten-hour intervals would be multiplied by having to wait a machine's convenience.

The third method requires exactly the same amount of setting up as the first. This is shown by the shaded rectangle in the right-hand lower corner of the figure. In this case the batches are not kept intact, but as soon as a sufficient quantity of parts has accumulated they are passed along to the next operation; hence we may term this the dispersed batch method. The passage time is about 230 hours, but with a suitable system and good planning and progress work this method can be varied by splitting the batch as required. One way is shown in method 4. Here the first operation is done in three equal stages; operation 2 with one set-up; for operation 3 the batch is divided into halves, there being a good interval, so that another job could be done in between. The treatment of the remaining operations is indicated clearly. The passage time is about 140 hours and setting time twelve hours.

It is quite obvious that the dispersed batch system improves the rate of flow for a given amount of setting up and size of batch. Methods 3 and 4 are obviously better than 1 and 2 respectively. But would 1 be inferior to 2, or 2 to 3, in practice? The total quantity of material treated in a given time is substantially unchanged by the variation in method. There is far less material in flow by the fourth than by the first method, but it does not lie so long between successive operations awaiting its turn to be moved and tooled. What is the relation between the expense incurred in production through the different systems? A simple way of making comparison may be presented. Without any pretensions to great accuracy, it is probably sufficient for a general survey. Let us imagine two factories built and equipped exactly alike to do the same amount of similar work. One of them is to run with a system by which it takes fifteen weeks from the date an order is commenced until the first deliveries are made; and the other, with exactly the same plant, but a different system, requires only five weeks. These factories start together on a certain day, having previously produced nothing. To both of them we deliver during the first week sufficient in money, or the equivalent, to set them going, and so on in successive weeks. When they are in full swing they each take £M in material, £W in direct wages, and, subject to amendments we shall find later, £B in on-costs. During the earlier weeks the on-costs would be less than £B because certain of the staff would not have entered to work, power and other incidentals would be less. It being only a rough survey, there is no need to split hairs, so we will make a convenient assumption—which is reasonable—that three-fifths of the on-costs is a constant burden and two-fifths varies with direct wages. Now during the first week the first factory can only do one-fifteenth of the full amount, since it takes fifteen weeks for the work to flow through. Therefore $\frac{£W}{15}$ is absorbed in direct wages, $\frac{£3\,B}{5}$ in constant burden, $\frac{£2\,B}{75}$ in variable on-cost, and £M in material. It is a little difficult to see that the full quantity of material is taken, and yet only a small wages bill incurred for work on it. Clearly it must be so, for the full quantity must lie in every weekly stage of progress later on, or the output could not be maintained. It is this way: the operators will seize the materials for the first operations; several will have to change their occupations during the week and take fresh material; some will work steadily without variation. The total result of their work will equal one-fifteenth of the whole amount to be done in one week when the factory is in full swing, on the equivalent of £M worth of material. During the second week the factory will require—

$$£\left(M + \frac{2\,W}{15} + \frac{3\,B}{5} + \frac{4\,B}{75}\right),$$

and so on, week by week.

Thus at the end of fifteen weeks it will have reached the point of delivering saleable output and have cost

$$£\left(15\,M + 8\,W + 9\,B + \frac{16\,B}{5}\right) \quad . \quad . \quad (1)$$

Similarly, the other factory will in five weeks cost

$$£\left(5\,M + 3\,W + 3\,B + \frac{6\,B}{5}\right) \quad . \quad . \quad (2)$$

Ignoring profits, each will turn out the equivalent of what it receives after the fifteenth and fifth weeks respectively, and thus the first factory has always an extra burden equal to the interest on the difference between (1) and (2). This difference equals

$$£(10\,M + 5\,W + 8\,B \quad . \quad . \quad . \quad (3)$$

Assuming that M equals W and B equals $\frac{3\,W}{2}$, the last expression reduces to £27 W, so that, roughly, the extra capital outlay is equal to about six months' wages. Allowing 2½ per cent. as interest for six months, it is obvious that it would pay to spend that amount in extra setting and similar expenses to obtain quick movement, for actually the on-costs of the second factory would be less than the other, because its size could be reduced, far less floor space being necessary.

This proves that the amount of setting time should be judged in relation to the rate of flow and that a rapid flow is by no means of little economic importance. The intact batch system prevents quick flow unless the lots are made very small indeed, but it can never be better in this respect than the dispersed method and is generally far inferior. Since it is so popular, are there any advantages belonging to it and not to the alternative system? To settle this we must consider several possibilities. With intact batches the bonus payments to operators are paid after each operation is cleared. If there are any defective parts to rectify or in any way quantities are different from what they should be, it can be brought home to the responsible party very easily. The size of each batch is determined by its production order and occasions no further worry or planning to progress-men. If the expected rate of flow is not realised the batch can be hastened—at the cost of further setting—if necessary, by issuing sub-orders. If the work is allowed to lie beside the machine on which it was last tooled until the whole batch is ready to send forward, the production order saves any other forms of instructions; but since it is desirable to separate those parts which have been inspected from those which have not, it is more usual for partial deliveries of the work to be sent forward and held in the view-room or works depôt until the whole batch is ready to be advanced to the next operation. As soon as the batch is thus separated its production order must be supplemented by some kind of identification tickets, which require a little extra clerical work for making them out, and extra records in inspection, progress and wages or bonus departments. If the production orders are large the work flow is very sluggish. If they are small their numbers must be multiplied together with all records which relate to them in other departments. It is easy to see, therefore, that the intact batch system tends to small orders, excessive setting time, and multiplication of clerical work. But, being rigid, it is a mechanical arrangement which can be worked without constantly scheming to save, and, in fact, it gives few opportunities to introduce any changes or economies affecting batches already passing through.

The dispersed batch system in its simplest form is represented by the third method in the graph. The flow is not quite so rapid, theoretically, as by method 2. The difference in the setting time required is, however, ten hours in the example given, or, roughly, 2¼ per cent. of the direct production time. This fact alone gives the dispersed batch almost a decisive advantage, for it is obviously better than method 1. A second advantage is that the production orders can be as large as desired without interfering with the rate of flow. Each can cover the required output for several months; but it is usually better to choose shorter periods to prevent errors accumulating unduly in such a mass of stale figures and records that it would be hopeless to search them to find mistakes. The number of orders can be minimised, however, and made to cover suitable quantities—about three or four weeks' output is often convenient. Progress records, the number of set-ups for particular operations and other business fall in well with this if a special method of paying piece or premium bonus be employed, as described later. If the usual way of paying on contracts with batches of fixed sizes be adhered to it is preferable to decrease the size of the orders, or the operators will have to wait too long for their dues.

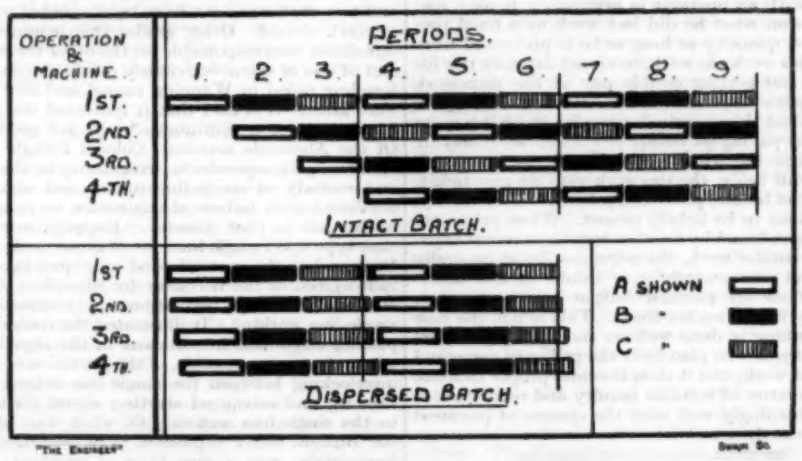


FIG. 2—INTACT BATCH v. DISPERSED BATCH

It might be suggested that the graphs in Fig. 1 relate to the operations on one component only, and while it is obvious that the dispersed batch system will increase the rate of flow of one solitary part, it does not follow that in practice—with a multitude of parts travelling together—there would be any gain, since other components might lie in wait while it was being dealt with. Differently expressed, the contention might be that while the mobility of component

A has been increased, the capacity of the plant has undergone no alteration; therefore B and C parts must suffer by corresponding amounts, leaving the net gain nil. It is extremely difficult to visualise the matter, but the parts B and C gain, in practice, similarly to A. When machines have an unvarying set-up and one job only it is easy to see; our difficulties enter when the same machines have to deal with A and B and C components. Let us consider a very simple case. Suppose A, B, and C each require four operations; each operation takes one-third week for one week's supply; there are four machines, one for each operation, through which the components follow in turn; the batches are equivalent to three weeks' output. We start with A on the first operation, intact batch system, no allowance for setting times or delays in pick-up. At the end of three weeks the first machine has executed its work on A, B, and C and is ready to commence the cycle over again. At the end of four weeks all the first batch of A have been completed. In six weeks B and C have also been finished. The cycle is repeated thereafter every three weeks.

With the dispersed batch system, but otherwise the same conditions, the working would be as follows:—At the end of three weeks A, B, and C first operations have been completed, and since the succeeding operations follow without any delay whatever, by hypothesis, all the operations on all three parts are completed in three weeks after the start instead of six weeks as by the previous method. Fig. 2 shows the working clearly. A small interval has been made between the completion of one job and the start of the next, because that is necessary and helps to make the diagrams more clear. After the end of the third week the plant remains continuously full by either method, but until then the intact batch system is losing, and this loss, it is important to notice, is never made up. Although hidden, it persists as long as the system is unchanged. The example of the magnitude of this loss already given proves that it may absorb a vital proportion of the capital.

The dispersed batch method, to arrive at its full advantage and make use of its elasticity without swelling setting times, requires first-rate planning and progress work. The whole amount of clerical work involved to run it, including job tickets, move instructions, and the like, is not large. Properly managed, it is rather less than the intact batch needs in practice, other conditions being the same; but there are several ways in which it can be done. On the whole the simplest plan is to issue instructions regarding production orders in detail to the progress and piecework or premium bonus offices and to the direct productive departments briefly. Production is then controlled in direction by progress—as a branch of planning—yet, of course, in consultation with the officers in charge of the operators. As regards payment by results, it can be done in the ordinary ways; but it will be found simpler and more satisfactory to let each contract be paid up weekly as far as possible and to adopt a system of piecework on time rates. If the term premium bonus seems more applicable let us call it that, but pay 100 per cent. of the time saved by operators instead of a fraction of that amount. Then, if basis times are set fairly, the operators can be paid weekly on results although the whole batch has not been completed. There are certain safeguards to prevent unfair happenings which must be arranged. In any case the size of a contract with an operator is arbitrary; it may just as well be on what he did last week as a fixed predetermined quantity so long as he is prevented from hoarding his work one week, receiving daywork pay for the time and getting double pay at the piecework rate the next week in addition. It is quite easy to guard against this—or similar results which are quite honest—by paying on weekly job tickets and carrying over to the following week should the piecework earnings fall below the daywork rate on any ticket. The result of failure, providing prices are set correctly, is too serious to be lightly passed. When prices are guessed at or found by another way than actual experience on similar work, the set times are so generally wrong that one scarcely ever thinks of the unfortunate effect on planned output when operators frequently fail to realise them. This is not the case when planning is done well on thoroughly practical lines and those who plan have the power to command the flow of work, and it then becomes proper to make failure a matter of suitable inquiry and report which fits in exceedingly well with the system of payment just advocated.

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ACCORDING to the *China Clay Trade Review*, the future of the Ayrshire bauxitic clay deposit lies mainly in its use as a refractory. The highest-grade material is perhaps not present in very large quantities. Of inferior grade with refractory quality of Seger cone 30–31 there is abundance. The clay is never found in anything approaching a plastic condition. When ground to a fine powder, however, some of the varieties which approximate most nearly to kaolinite in composition are slightly plastic, but not sufficiently to be easily workable. In the use of the material for the manufacture of refractory ware it has been found necessary to combine it with a suitable plastic clay, which is fairly refractory and free from the usual impurities of the bauxitic clay, such as iron and titanium. By this means, and by burning at a sufficiently high temperature to bring about as much contraction as possible, an excellent brick for use in high-temperature furnaces can be produced.

## Railway Accidents.

THE considerably reduced traffic last year brought, in one direction, compensation to the railway companies. Their accident record was the best since railways began. There were 63 collisions in which passenger trains were concerned, as compared with 101 in 1920, 87 in 1911—ten years previously—and 106 in 1901—twenty years previously. The number of passenger train derailments was 38, as against 87, 73 and 62 respectively in the three years just named. Of goods train collisions there was a yet greater reduction. For this decrease, as we observed on page 1 of our issue of July 7th, the coal stoppage and general trade depression last year were responsible. Not only were there fewer train movements, but the men were not hurried and so took greater care. The recently issued report to the Ministry of Transport by Colonel Pringle provides us now with matter that allows for further comment on a subject that, practically, touches us all. We learn, for instance, that the number of accidents inquired into during the year was 18, which figure, except for the war years of 1916, 1917 and 1918, was, again, the lowest on record. That is, perhaps, the most significant item in the report. An official investigation is held into every accident—regardless of the personal or material damage—which suggests a weakness in administration, insufficient attention to upkeep, a shortage of accommodation, a lack of signalling, &c. Twenty years ago the number of inquiries was 44; in 1911 it was 23; and in 1920, 25. When, moreover, we turn to the primary causes of the 18 accidents, we find that 12 of them were assigned to failures of the men. In our opinion this number should have been 13, as Abermule was certainly due to human frailty. Thus, 5 can be said to have been at the companies' own door. Of these, 2 were cases of derailment, respectively due to insufficient maintenance arising out of war conditions and a broken tender spring hanger. Obviously they come under the three accidents classed as due to "failure and insufficiency of equipment," and we may take it that the Buxton boiler explosion was the third of these failures. There is nothing to identify the two cases of "faulty methods of signalling and of yard working"; in fact, except in the one case of Abermule, no names of places are mentioned by Colonel Pringle, and we thus have to rely on our personal knowledge of the circumstances of each accident to identify the instances referred to in the report. We feel safe, however, in saying that one of these two was the result of an obsolete method of signalling that was being replaced by automatic signalling at the time the collision occurred, and the other was caused by the running away of some coaches which would have been better placed in a siding than allowed to remain in a passenger bay line where the gradient is a falling one of 1 in 76.

Now, let us see to what extent the companies can be held responsible for the twelve accidents due to failures of the men. Colonel Pringle classifies six of these mishaps as due to errors of enginemen, and says of three of these that automatic train control would have been the most certain preventative, and of a fourth that it would have been avoided by disallowing an undesirable method of "warning acceptance." Three of the twelve cases of failure lay with signalmen, and two of these might have been avoided by the use of track circuit. Other grades than enginemen and signalmen were responsible for the other three failures, and of one of them—obviously one in which a wagon coupling failed in Wapping tunnel and two servants were killed—it is said that it indicated the necessity for the use of a continuous brake for goods trains. Of the Abermule accident, Colonel Pringle observes that laxity in supervision, irregularity in the working and custody of single-line tokens and instruments, combined with failure of enginemen to examine the token, led to that disaster. Happily, accidents of that type upon single lines are of great rarity in Great Britain, but the case afforded an object lesson to all railwaymen of the necessity for discipline and exact obedience to the regulations in connection with single-line working. It illustrated the desirability for placing single-line instruments in the signal-box, or, where that is not possible, of the provision of electrical interlocking between the single-line tokens and the starting and advanced starting signal giving access to the single-line section. Of what was, obviously, the Buxton boiler explosion, it is remarked that it, fortunately, was a rare type of accident. It was attributed to inexact valve fitting and insufficient precaution in methods of testing steam gauges against the safety valves. The lesson to be learnt from it is the necessity for exact and standardised methods of manufacture of important locomotive fittings, *e.g.*, safety valves, and more efficient supervision of enginemen's reports on engines. Another lesson taught by the accidents of 1921 is that—evidently in the collision in a fog at Queens-road, Battersea—detonators were liable to fail to convey an intended warning to enginemen.

The point we are anxious to make is that these excellent accident figures bring to the companies a certain responsibility. They have set up a record which the public will expect to be maintained. It will be useless for the companies to plead that the year 1921 was a year of reduced traffic; those who travel will look to the railways proportionately to improve their methods to suit the greater movement. What, moreover, is instructive in this respect is that in fifteen of the eighteen cases the inspecting officer made a recommendation of which only one was not accepted by the company concerned, and two are described as under consideration. In other words, after two-thirds of the accidents the respective companies had done something which, had it been done earlier, would have saved the accident. It is the same with the accidents to railway servants. There, again, a record has been established, but it yet remains the fact that, during 1921, there were over 3000 such accidents. Whilst 65 per cent. of them were ascribed as due to misadventure or accidental causes and 31 per cent. to want of care by the man himself or by a fellow-servant, the remaining 4 per cent. could have been avoided had, for example, capstans, wagon brakes, engine equipment, turntables, &c., not been defective or had wagons been provided with brakes on either side or had there been a sufficiency of clearance between wagons and structures, *e.g.*, doors, platform walls, &c. On this matter of accidents to servants it is, be it noted, remarked that recommendations were made and the necessary action had, where reasonably practicable, been taken under all these heads—the 4 per cent. of cases—with good effect.

We have been somewhat impressed by the small number of coupling accidents. Twenty years ago there were 14 men killed and 571 injured when coupling and uncoupling wagons, and ten years ago there were 12 killed and 611 injured in the twelve months. In 1921 these figures were 3 and 367 respectively, and we would have reason therein for much satisfaction were it not for the fact that in the previous year 15 were killed and 543 injured. The most serious aspect of accidents to railway servants is the number of casualties to platelayers. Last year out of 228 servants killed, 65, or 28.5 per cent., were platelayers, and of 233 accidents to platelayers, 28 per cent. were fatal. Twenty years ago, it is true, matters in this respect were much worse, as in that year—1901—121 platelayers were killed, and the percentage of fatal cases was 44.7. Therein there is room for much educational work by the companies. They might take a leaf out of the book of the Great Western, which, as related on page 278 of our issue of September 15th last, has issued a pamphlet, "Safety on the Permanent Way," to all its platelayers and those who have to work on the track, wherein, by pictures and story, it is brought home to such men how they incur danger to themselves and how they may avoid it.

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## Obituary.

### JOHN WILSON.

THE death of Mr. John Wilson is announced as having taken place at Upminster, on Monday of last week, the 6th inst. Mr. Wilson was the son of Robert Wilson, and was born at Ardrishaig, in Argyllshire, on April 21st, 1846. He was educated at Dollar Academy, Clackmannanshire, and on leaving that Institution he took up his apprenticeship as a mechanical engineer, serving three years in the locomotive shops of the Great Western Railway at Worcester, and two years with the Worcester Engine Works. He then adopted the profession of civil engineer, and, in 1866, came to London to be articled to his uncle, the late Mr. Edward Wilson, of 9, Dean's-yard, Westminster.

Mr. Edward Wilson was consulting and constructional engineer to the Great Eastern, Great Western, Metropolitan, and other railway companies, and whilst with him his nephew gained a very varied and extensive experience in railway work and parliamentary procedure. Among the works on which he was actively engaged were the Great Eastern's Metropolitan extension; the construction of Liverpool-street Station and of that company's East Norfolk lines; and the Banbury and Cheltenham Railway, now part of the Great Western system. At the death of Mr. Edward Wilson in 1877, Mr. John became a partner in the firm of Edward Wilson and Co., and it was to the designs and under the supervision of that firm that Parkeston Quay, which deals with the continental traffic of the Great Eastern Railway, was built.

In 1883 Mr. John Wilson left his firm to take up the appointment of engineer-in-chief to the Great Eastern Railway Company, and remained in its service until his retirement in 1910. During this period many new works were carried out. Liverpool-street Station was enlarged to embrace what is now known as the East Side; Southend and Southminster were coupled up with the Great Eastern line; Parkeston Quay was extended, large developments were made in the quays and docks of Lowestoft, many new lines were constructed, some heavy bridge renewals were effected, and other works completed.

Mr. Wilson was a member of the Institutions of Civil and Mechanical Engineers, and past-President of the Permanent Way Institution.

# A Seven-Day Journal.

## A New Road Route Guide.

After the "Silent Guide," whereby, with the pressing of a selected button, the point of interest on a map is illuminated and instructions how to get there are made apparent, there has now been introduced a device for use on tramway cars, motor omnibuses, &c., by which the passengers are enabled to discover without asking where they are or how far off their destination is. The automatic road guide consists of a fixed pointer, behind which there is unwound a map of the route traversed. The spools are rotated by means of a flexible shaft geared to the road wheels. A space measuring 3ft. by 1ft. is visible on the map at any instant, and on it are marked the points of interest, stopping places, fare stages, &c., the length shown representing an actual distance of one mile of the route. Very large sums of money, it is understood, have been spent in logging the great main roads and principal arteries of the country for the purpose of this guide. An example of it was recently set to work for the first time on the Metropolitan Tramway Company's system between Euston-road, London, and Enfield.

## Inter-Imperial Trade.

Closely following Colonel Armstrong's recent remarks at Edinburgh on the subject of inter-Imperial trade and how it might be fostered, the Federation of British Industries has decided to take an important step in connection with the Canadian National Exhibition to be held at Toronto next August. This annual Exhibition was founded in 1879, and is probably the most important trade gathering of its kind in the world. The grounds cover 264 acres and accommodate eighty buildings. Last year, in the course of the fortnight for which it was open, over 1,300,000 persons visited it. The exhibitors hitherto have mostly been Canadians or Americans, but in view of the restrictive tariff which the United States have placed on Canadian goods, combined with the very favourable harvest returns in Canada this year, the opportunity for a considerable increase in the trade between this country and the Dominion seems to be very promising. To assist matters in this respect, the Federation of British Industries is arranging for a collective exhibit of British goods. It has reserved an adequate amount of space in one of the principal buildings, and is arranging to send out in advance an expert staff to erect the stalls, receive, unpack and stage the goods, and, if desired, supervise them during the run of the Exhibition. In this way, for an inclusive fee, British firms will be enabled without trouble to be represented in an adequate and impressive manner. It is hoped that the support forthcoming for the scheme will be such as to justify the efforts being made by the Federation, and to uphold the reputation of British manufactures.

## British Cast Iron Research.

The first annual report of the Council of the British Cast Iron Research Association for the year ending June 30th, 1922, records the fact that although there are about 3000 foundries in the country producing grey or malleable cast iron, only 202 of them are members of the Association. With a view to encouraging membership, the Council proposes to reduce the subscription rates to those ironfounders who employ a large number of unskilled moulders. In spite of the comparative apathy shown by the industry, the Association has made a good beginning with the programme of research work drawn up at the outset of its existence. It is at present investigating moulding sands, and, in conjunction with the British Refractories Association, refractories affecting the cast iron and blast-furnace industries. In co-operation with the British Motor Research Association, it is investigating motor car engine cylinder castings, and as soon as sufficient funds are available, it is proposed to institute an extensive research in connection with malleable castings with a view to securing a uniform standard of production throughout the country. Shrinkage defects are being actively studied, and extensive tests have been made with a view to discovering the effects of carbon, silicon, manganese, sulphur and phosphorus on shrinkage, draws and sink holes. At prbsent funds will not permit the full programme of research being carried out, and it is therefore proposed to confine attention in the coming year to the investigations already begun. The Association has been fortunate in securing as the director of research Dr. Percy Longmuir, a well-known research worker in iron and steel, and until recently works manager at the Stocksbridge Works of S. Fox and Co., Limited.

## The Isherwood System in America.

After a fight lasting eight years, Sir Joseph Isherwood has succeeded in winning his case against the Newport News Shipbuilding Company. In 1910 the Newport News Company entered into an agreement to build ships on the Isherwood longitudinal framing system, and on the first vessel so built duly paid royalties. Subsequently, the company built thirty-three longitudinally framed vessels, of which ten were constructed in accordance with patents taken out in the United States by the company's naval architect. Sir Joseph claimed royalties on all these vessels, but the company refused to pay for any of them on the grounds that the contract was obscure, that the Isherwood patent would not be granted in the United States, or if it were granted it would not be valid. The Judge of the District Court of East Virginia has now pronounced his finding in the matter. He has awarded Sir Joseph royalties at the rate of 5s. per ton gross on all longitudinally framed vessels built by the Newport News Company up to July, 1910, and at the rate of 3s. per ton gross on all similar vessels built subsequently. The ten vessels constructed in accordance with the company's own patents are included in the award, for the Judge held that these patents embodied the basic principles of the Isherwood system. In addition, Sir Joseph has been granted an injunction against the company preventing it from building ships on his system without first submitting the plans to him. The judgment means the payment of many thousands of pounds to Sir Joseph by way of royalties.

## High Speed Wireless on Liners.

During the voyage of the White Star liner Majestic to New York, which she completed on Tuesday, a high-speed wireless telegraph service was successfully inaugurated. The wireless messages dealt with by the vessel had reached nearly 50,000 words per trip, and in order to facilitate their transmission the Marconi Company, by arrangement with the White Star Line, installed an automatic transmitting apparatus on board. Instead of being restricted to an average of about 20 words a minute, the general rate for hand transmission from ship to shore, messages may now be sent at the rate of about 100 words a minute. The Majestic's installation represents the first occasion on which the Marconi automatic high-speed apparatus has been fitted on board a ship, and will be followed by similar installations in other important White Star vessels.

## London's Air Defences.

In pursuance of the War Office's plan, announced last July, for the formation of two Air Defence Brigades for the London district, recruiting for the artillery units was opened some time ago, and has now been begun for one of the two engineer battalions which are to form part of the force. The unit is designated the 10th (London) Anti-Aircraft Battalion, Royal Engineers, and like the other units of the force, will be organised on a Territorial basis. The work of the battalion will consist of the operation of searchlights, engines and sound locators. Engineering students and men with technical knowledge of electrical and mechanical engineering are particularly invited to join the new unit. The headquarters of the battalion are situated at the Duke of York's School, Chelsea, S.W.

## A Trade Union's Finances.

In the current number of the monthly journal issued by the Amalgamated Engineering Union some details are given of the manner in which the Union's funds have been expended during the period from its formation in July, 1920, to June 30th, 1922. According to the last return, the amalgamated membership was 357,871. During the period referred to, the total sum paid out to the members by way of assistance in various forms was no less than £4,056,458. Some of the principal items were as follows:—Unemployment benefit, £2,672,306; superannuation benefit, £429,553; sickness benefit, £388,525; contingent benefit, £244,620; supplementary benefit, £196,948. The total cost for administration was less than 13 per cent.

## Wages in the Royal Dockyards.

On Tuesday the Industrial Court issued its award in connection with the claim made by the shipbuilding trades workers in the Royal dockyards for a 12s. per week advance in wages. The men urged that recent wage reductions had brought hardship and privation, and were out of keeping with the prevailing cost of living. It was also advanced that the Government should pay rates which would make possible a decent standard of life on the part of its workers without reference to the exigencies which might affect private shipbuilding establishments. Against this view, the official attitude adopted was that the only sound basis for determining rates of pay in the dockyards was by reference to the rates paid in commercial establishments for corresponding trades, although exact equality was perhaps not to be aimed at. The Industrial Court rejected the men's claim on the broad ground that difficulty would be bound to arise if the dockyard workers were to receive higher wages than similar workers in outside establishments, and that as the dockyard workers had participated in the increases of wages secured by private yard workers, so, too, should they partake in the recent reductions. At present the base wages in the dockyards are 24s. per week for labourers, 41s. for the majority of the skilled workers, and up to 48s. for the remainder. In addition, all alike receive a weekly war bonus of 21s. The Admiralty has posted notices informing the workers that from November 19th onwards the bonus will be reduced to 17s. In private establishments the bonus was for some time fixed at 17s., but on November 1st it was reduced by the first of four instalments of 2s. 6d. each.

## Pilotless Aeroplanes.

It is announced that the United States Army Air Service has made successful tests of an automatically controlled pilotless aeroplane. Flights of over 90 miles have been recorded, and it is claimed that the machine loaded with bombs can be directed with "astounding" accuracy against any target on or off the ground. The control exercised is no doubt obtained by wireless transmission. The idea is, of course, far from being new. We discussed it fairly fully in a leading article in our issue of April 11th, 1919, on the occasion of the announcement of the beginning in America of, apparently, the experiments which have culminated in the success now recorded. Even at that date the performance now claimed for the American machine had been surpassed by that of a French wirelessly controlled aeroplane. The statement attributed to the American Air Service that its machine constitutes "the most important post-war development of new engines of war" is therefore a little more than bombastic. Actually, from the military point of view, the wirelessly controlled aeroplane is for technical reason of exceedingly limited value, one of the most notable of its restrictions being the ease with which the opposing force can divert it from its target by jambing the directional signals. We may recall in this connection the fate which overtook what was intended to be one of the largest Zeppelin raids during the war, that planned for the night of October 19th, 1917, which was brought to disaster by our interference with the enemy's wireless guiding signals.

## The Marine Exhibition.

The Marine and Small Craft Exhibition, which was opened at the Agricultural Hall, Islington, on Tuesday, is one of the most pleasant shows we have visited for a long time. Sailing boats and well equipped up-river craft lend an artistic touch to the scene, while the stands devoted to engines and fittings provide a more substantial interest. There are all sorts and kinds of internal combustion engines, ranging from some 80 horse-power down to about 1 horse-power; but in the course of a tour of the hall we failed to discover a single steam engine. There is one engine on show which at first sight might be taken for a steam set that is, in reality, a double-acting hot-bulb oil engine, but as we hope to describe some of the more interesting exhibits in an early issue, we will not enlarge upon them here. The organisers of the Exhibition are to be congratulated on the fact that it was complete on the opening day, so that visitors were not distracted by the noise, so often heard at shows, of carpenters hastily finishing half-completed stands. The official opening ceremony, which took place on Wednesday, was also noteworthy on account of its having been performed with the assistance of wireless communication by the Duke of York at Buckingham Palace. A programme of meetings and lectures has been arranged in connection with the Exhibition, and includes such subjects as the equipment of small yachts with wireless apparatus, hydraulic propulsion, and notes on propellers. The Exhibition remains open until Friday, the 24th inst.

## Clyde-built Fullagar Engines.

It is understood that John Brown and Co., Limited, of Clydebank, are now conducting tests on one of a pair of large Camellaird-Fullagar engines which they have just completed. The engine has six cylinders and will develop 2250 brake horse-power. The two together, we gather, have been sold to Japanese owners for installation in a large vessel now being constructed in their country. These engines represent a very considerable step forward in size from the 500 horse-power engine fitted in the coaster Fullagar and the two 500 horse-power engines of the Anchor-Brocklebank liner Malia.

## Electrical Undertakings in Japan.

THE use of electricity for lighting purposes in Japan began in 1887, when the Tokyo Electric Light Company commenced a public supply with a generator designed to light seventy-five lamps. In the year following several other generating stations were completed, including an 80-kilowatt station, built by the Kobe Electric Lighting Company. In May, 1889, the Osaka Electric Lighting Company established the first alternating-current plant, which had a capacity of 30 kilowatts and worked at a pressure of 1040 volts, the generator being built by the Thomson-Houston Company. Other plants were afterwards put into operation at the cities of Kyoto, Nagoya, Yokohama, &c., and by the end of the year 1900 the total capacity of the plant installed amounted to 1500 kilowatts. In 1891 the first water power scheme, which involved the erection of four 120 horse-power water wheels and two 80-kilowatt generators, was put to work, the scheme being the outcome of the Kyoto municipal scheme of draining Lake Biwa.

In the electric traction field the Kyoto Electric Railway Company took the lead in 1895, and the example set was followed by the Nagoya Electric Railway Company in May of 1898. In 1898 the Koriyama Silk Spinning Company put a 10,000-volt, 15-mile transmission system into use, and since that time water power and high-tension schemes have made material progress. A water power station at Komabashi, with a capacity of 15,000 kilowatts, was started in 1907 by the Tokyo Electric Light Company. From this station current is transmitted to Tokyo at a pressure of 65,000 volts. A much larger and much higher voltage scheme was completed by the Inawashiro Hydro-electric Power Company in 1914, the transmission line, which works at a pressure of 115,000 volts, extending from Inawashiro station to Tokyo.

The superiority of electricity for lighting and power purposes is now well appreciated in Japan, and the demand for current increases from year to year. Even at villages which are remote from industrial and commercial centres generating stations are in successful operation, but the war naturally proved a serious check to progress. Supplies of electrical goods, which had been imported into the country before the war, were stopped on the outbreak of hostilities, and central stations had to stop or curtail extensions. The general industries, however, became very active towards the end of 1915. The demand for electricity increased in an unprecedented manner, whilst the increased cost of coal led to more attention being paid to the utilisation of water power. In 1918 the demand for electricity was so pressing, especially in the industrial centres, that the Government and others concerned were forced to adopt measures which would ultimately satisfy those demands. A number of large hydro-electric undertakings were planned for the principal industrial districts throughout the country, the important schemes being as follows:—(*a*) The Nihon Suiryoku Kaisha scheme of the Japan Hydro-electric Company, involving a plant capacity of 140,500 kilowatts and a 130-mile, 154,000-volt transmission system to Osaka; (*b*) the Nihon Denryoku Kaisha scheme, having a 89,680-kilowatt plant capacity and a 125,000-volt, 150-mile transmission line to Osaka, and promoted by the Japan Electric Light Company; (*c*) the Osaka Soden Kaisha scheme of the Osaka Power Transmission Company, this being a 35,000-kilowatt, 115,000-volt scheme, with a 130-mile transmission system to Osaka; and (*d*) the Shinetsu Denryoku Kaisha scheme of the Shinetsu Water Power Company, the total plant capacity in this case being 100,000 kilowatts. The working voltage of a 100-mile transmission line extending to Tokyo has been fixed at 66,000 volts.

According to a publication issued by the Bureau of the Electrical Exploitations Department of Communications, both the total number of undertakings and the total capacity of installed plant increased fourfold during the ten years 1909 to 1918. The increase in the use of water power for generating electricity and the decrease of the number and capacity of isolated power plants have been very marked. Manufacturers in Japan prefer to purchase cheap electrical power from the hydro power stations rather than generate power themselves. At the end of 1918 all the cities and about 7000 villages were illuminated by electricity, and about 11,900,000 electric lamps were being supplied from the central stations. Thirty per cent. of these lamps, or, roughly, 3,700,000, were in Tokyo, Osaka, Kyoto, Kobe, Yokohama, and Nagoya. At the end of 1918 there were about 80,000 electric motors supplied with current from the central stations, whilst the aggregate capacity of plants in isolated factories was 637,000 horse-power.

Considerable progress has been made in connection with the utilisation of electricity in the metallurgical and chemical industries. More than 1,000,000 horse-power has been used during recent years in these industries, whereas in the year before the war the total horse-power was only 390,000. As regards electric railways, the track mileage electrified in 1909 was 211, and the number of cars in operation was 1800, the corresponding figures for 1918 being 950 and 4600 respectively. During the latter year about 981,570,000 passengers were carried. The total amount of capital invested in all electricity supply and railway undertakings was estimated at the end of 1919 to be 1,000,000,000 yen, of which about 850,000,000 yen were paid up. On the average the electricity supply undertakings had been paying 8 to 10 per cent., but their reserve for depreciation and reserve fund is often insufficient.

Although the advantages of interconnecting water power stations were recognised in the early stages of electrical development, the scheme was not adopted to any appreciable extent until the amalgamation of a number of companies took place in Kiushu Island. Two important interconnection schemes were then carried out in two of the largest cities, namely, Tokyo and Osaka. In 1915 the Government passed a law which gave the Minister of Communications power to order any electric supply undertaking to interconnect its stations with others when it was deemed necessary for the welfare of the public. The available water power of the country is estimated at 7,000,000 horse-power, on the basis of the minimum flow, and about 1,000,000 has been developed.

## The Motor Car Shows.

No. III.*

SUNBEAM.

REFERENCE has been made in our notice of the shows to the subject of all-round brakes to which several British firms are now paying attention, prominent amongst which is the Sunbeam Motor Car Company, Limited, Wolverhampton. The type of front wheel brake adopted by this company is that patented by Perrot, in which the front wheel shoes are operated by a cam and a universally jointed cam

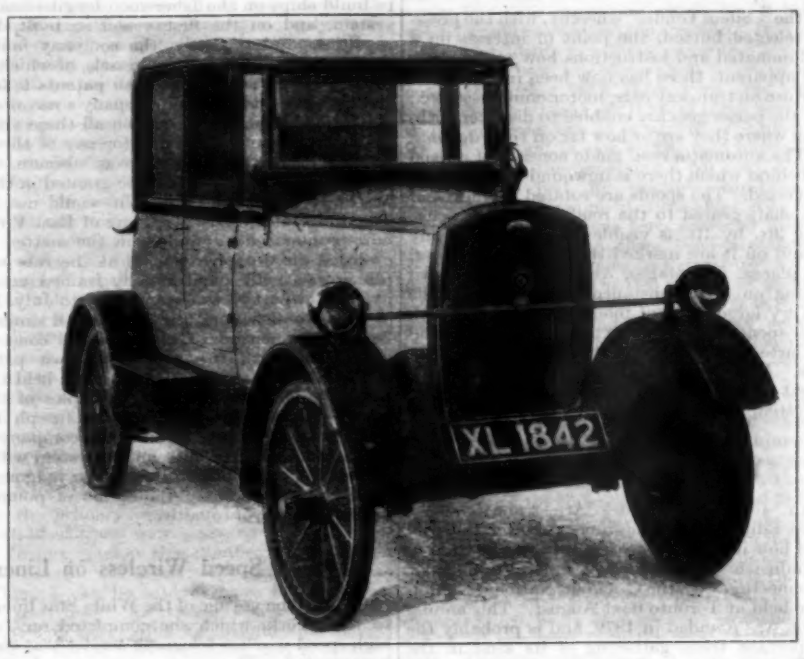
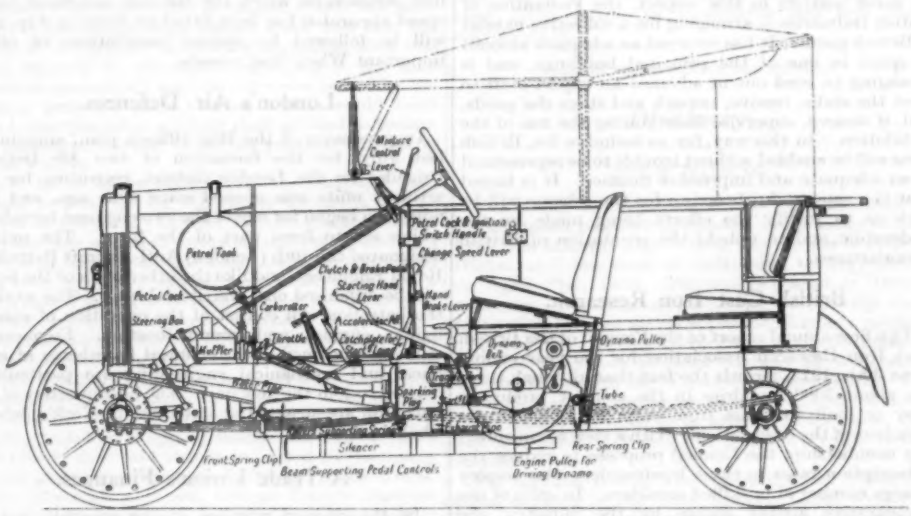



FIG. 20—10-H.P. TROJAN CAR



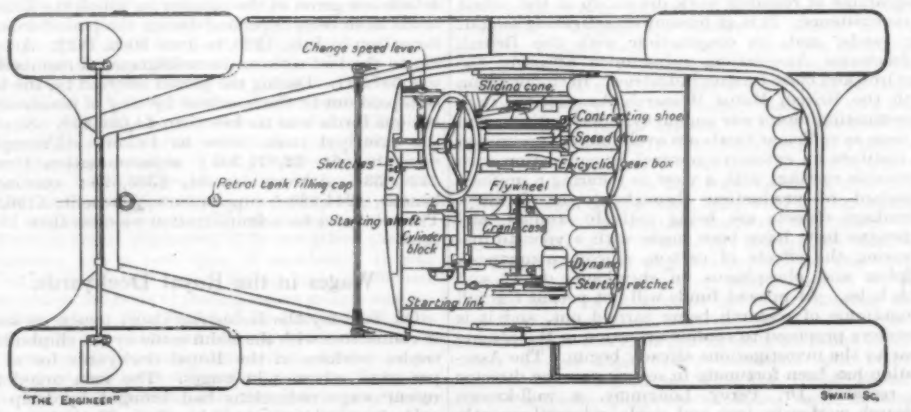




FIG. 21—SECTION AND PLAN OF TROJAN CAR

shaft, the centre of the universal joint lying on the prolonged centre lines of the swivel pins. In other respects the design of the brakes is of the type generally used. The servo mechanism adopted is similar to that first used on the Hispano car; a low-speed drum is driven by a worm with a reduction of

* No. II. appeared November 10th.

about 22 to 1 from the main shaft to the gear-box. It is therefore positively driven from the car wheels when the car is travelling in the forward direction.

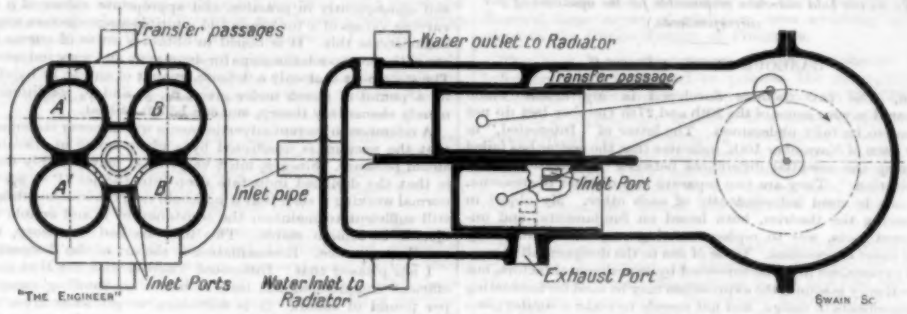



FIG. 23—CYLINDER ARRANGEMENT OF TROJAN ENGINE

The direction of rotation of the drum with the car travelling forward is such as to apply the road wheel brakes when the servo shoes are expanded. When the car is running in the reverse direction the drum is driven by means of a ratchet dog which allows the brakes to be applied without being affected by the servo drum, which can still rotate in a forward direction with the brake operating gear, the additional braking power not being required when the car is moving slowly backwards.

The servo mechanism is interposed in the brake operating gear in such a way that the tension of the brake rod or the resistance that the brake shoes meet on the drums causes the servo brake shoes to expand. The first application of the foot to the brake pedal, which in the Sunbeam car operates the brakes on all four wheels, takes up the clearance between the drums and the shoes. Further motion, owing to the resistance of these shoes serves to expand the shoes in the servo brake and assists the foot as the pressure is applied. The mechanism involved consists of a horizontal shaft placed transversely across the chassis at the rear of the gear-box. This shaft is tubular, and carries at one end the brake drum of the servo brake, and is rotated by the bronze worm wheel meshing with a steel worm on the gear-box main shaft. Free to rotate in this transverse hollow shaft is another shaft which carries the servo brake shoes and the anchor piece. Also supported on this second

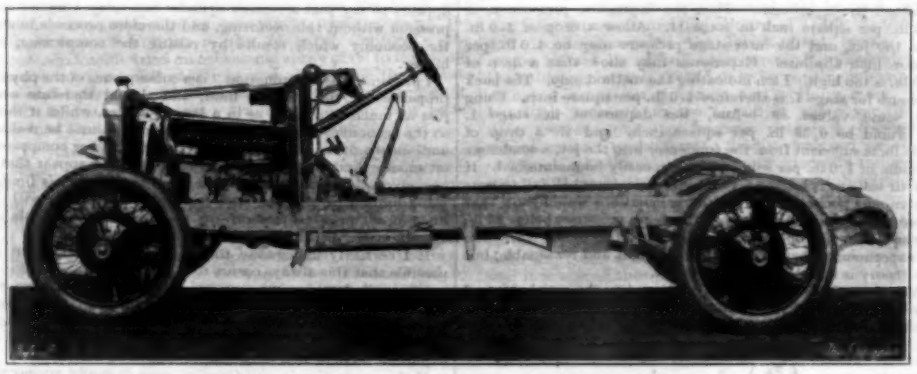


FIG. 24—16-H.P. SIX-CYLINDER DAIMLER CHASSIS

shaft and free to rotate thereon is the cam which operates these shoes. This cam carries a lever which is directly connected to the foot pedal. A stop is provided for the brake pedal in its free position and also for the second shaft, and this stop determines the amount of clearance between the brake and servo shoes and the servo brake drum. The secondary or brake shaft carries a small bevel differential gear to the sun wheels of which are attached the two shafts operating the front wheel brakes, which are thus compensated, and a lever rigidly attached to the shaft operates the brakes on the rear wheels.

A feature of this system which is worthy of special note is that as the braking effect given by the servo brake is obtained from the rotation of the servo drum the skidding of the wheels which allows the drum to stop immediately releases the brake, and locking of the wheels is prevented.

### TROJAN.

Although, as previously mentioned in these articles, the shows this year were singularly devoid of heterodox designs, there was one car which can certainly lay claim to originality in regard to several features. This is the Trojan, designed by Mr. L. Hounsfield, and built by Leyland Motors, Limited, at their Kingston works. A general view of this car is given in Fig. 20, while Fig. 21 represents an elevation and plan showing the general arrangement of the car and its motive mechanism. Fig. 22 is a diagrammatic sketch showing the arrangement of the engine cylinders. The whole design of the car shows much originality, but this remark applies particularly to the motor, which is of the horizontal two-stroke pattern with four water-cooled cylinders, coupled in pairs. There are no valves, and the bore and stroke of the cylinders are 2½in. and 4½in. respectively, the Treasury rating being 10 horse-power. Each pair of cylinders A $A^1$ and B $B^1$—Fig. 22—has a common combustion chamber, only one plug being required to fire the mixture in both, and each pair of pistons travels in the same direction simultaneously, driving one crank of a double crank shaft by means of a V-shaped connecting-rod. Crank chamber compression of the charge is used, and the mixture is drawn into the crank casing when the pistons are travelling inward to the left. It is pumped into the top of the pair of cylinders together with lubricating oil, correctly proportioned, as the pistons move outward to the right hand on the partial completion of the power stroke, the mixture entering the lower cylinder through an orifice in the head. The engine is so designed that the lower of each pair of pistons which opens and closes the exhaust ports always moves slightly in advance of the upper piston which controls the transfer port, so that the products of combustion—or the greater part of them—can escape before the transfer port is uncovered. On the inward stroke—to the left—the lower piston leads and closes the exhaust port before the top piston closes the transfer port. The differential movement of the pistons on the inward stroke causes the mixture to rush through the port connecting the combustion heads, and the turbulence thus produced expedites the process of ignition. Deflector heads are not required on the pistons.

It will be seen from the foregoing that there are only seven moving parts in the engine, namely, four pistons, two connecting-rods, and the crank shaft. The mixture enters the engine *vid* a long induction pipe to a hot spot over the exhaust ports where the petrol is vaporised, leaving the oil free for lubrication. The amount of oil mixed with the petrol is as 1 is to 32. The oil freed from the petrol gravitates to the bottom of the crank chamber, and by an ingenious system the alternate vacuum and pressure are made use of to send the oil along a duct into a chamber near one of the main bearings and thence through the crank shaft to the big end bearings, whence it is returned to the crank chamber. Ignition is by battery and coil. Epicyclic gearing giving two forward speeds and one reverse speed is used, and there is no clutch as usually understood. Instead, there are two expanding and contracting bands which lock both the lower and reverse gears, and a third band which locks the drums of these two gears together when the car is on top speed. To give a cushioning effect to the transmission the engine fly-wheel is coupled to the gear-box by means of a number of radial springs. The final transmission is by a duplex chain to the solid live axle, there being no differential. The engine and transmission gear are placed under the driver's seat, and a mechanical starter operated from the driving seat is provided. Being designed to run on solid rubber tires, particular attention has been paid to the spring suspension, which is remarkably efficient. Long flat cantilever plate springs secured above and below the front axles respectively, and arranged to give longitudinal movement, give the car a very easy motion over the roughest of roads. The engine is not intended for very high speeds—at 1000 revolutions it gives a road speed of 20 miles per hour. The car weighs 12¼ cwt., and the petrol consumption

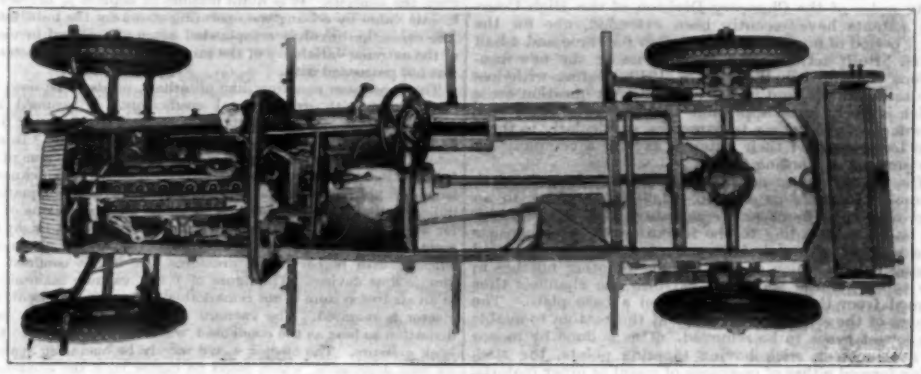


FIG. 25—PLAN VIEW OF DAIMLER 16-H.P. CHASSIS

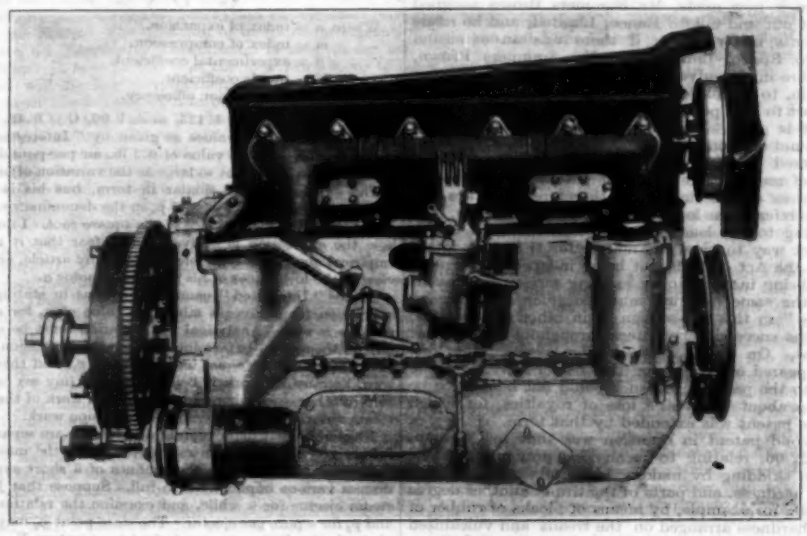


FIG. 25—SIX-CYLINDER DAIMLER ENGINE

is about 40 miles per gallon. The wheel base is 8ft., the track 4ft., and the ground clearance 9in.

DAIMLER.

Figs. 23 and 24 show a new 16 horse-power six-cylinder Daimler chassis, the engine being shown separately in Fig. 25. The sleeve valve engine has a bore and stroke of 66.5 mm. and 104 mm., the cylinders being cast monobloc. The crank shaft has seven bearings. The engine is fitted with an automatic carburetter with a petrol primer for starting purposes. A water valve is fitted in the return pipe to the radiator, and is connected to a lever so that the driver, by regulating the flow of water, can maintain the desired temperature of the engine. The carburetter draws its air from a muff which surrounds the exhaust pipe, and the induction pipe is heated on the "hot spot" principle. Beneath the fan is seen the Daimler-Lanchester vibration damper, which is carried on the end of the crank shaft; its casing forming the belt pulley for driving the fan. The car has a four-speed gear-box and Lanchester worm gear.

## Patents Extended.

By order of the Chancery Division of the High Court two patents have recently been extended, one for the short period of one year and the other for three and a-half years. Both actions were brought under the new provisions contained in the Act of 1919, dealing with loss due to hostilities, and in the first action a question arose which is likely to be applicable to many other cases and, therefore, of general use to patentees, particularly to those who have assigned their patents, say, to a company for the purpose of working them.

The patent under consideration in the first action is Summers Brown's patent No. 12,801/06 relating to an improved type fount and composing stick for use with the same. According to the invention the case consists of a number of metal strips mounted on a backing and having flanges which engage circular or other notches in the types. These types are fed into the channels thus formed from the top, and raised on a base plate. The flanges of the strips are cut away at the bottom to enable the lowest types to be removed. This is done by means of a composing stick having tapering points, the stick being formed either of one piece of metal or other material or of sections united by a joining piece.

The inventor granted an exclusive licence to use the patent to Roneo, Limited, and in 1920 assigned it to that company, which as registered legal owners applied for an extension of the patent on the ground of loss due to hostilities. It seemed there was no doubt some party had lost due to the war, either the inventor or the firm or both, but as the Act specifically covers only the patentee who had suffered loss owing to the war a large amount of argument was involved as to how far the inventor had lost or the company had lost otherwise than as manufacturers when distinguished from patentees.

According to the applicants' counsel up to a date subsequent to the termination of hostilities, the applicants were exclusive licensees of the patent, and they paid a royalty to the grantee. During the war the sales of the patented article were negligible. The present patentees, Roneo, Limited, having been engaged on work of national importance during the war as a controlled establishment, their export trade had practically vanished, and it had been impossible to develop their normal business.

According to the official report of the judgment, Mr. Justice Sargant found that the facts are that Mr. Summers Brown, some little time after the granting of the patent, granted an exclusive licence to Roneo, Limited, and Roneo, Limited, have since been the only persons manufacturing in accordance with the Letters Patent. There is no doubt that the manufacture of the patented article was seriously prejudiced by the war, and losses were suffered by Roneo, Limited, as licensees, and it is also the fact that losses were suffered during the period of the war by the patentee, Mr. Summers Brown, as patentee, by reason of the diminution of the royalties payable.

It appears, however, that in the year 1920, some time after the cessation of the loss in respect of which the application is now made, Mr. Summers Brown assigned the patent out and out to Roneo, Limited, and he made arrangements under which, if there was an extension granted to Roneo, Limited, he, Mr. Summers Brown, was to share in the advantages that they would presumably obtain, to the extent of £500 a year. That seemed to the court to be a perfectly fair bargain.

Then it is said:—The only person who has suffered damage is not a patentee, because though Roneo, Limited, have suffered damage they have suffered that in their capacity of manufacturers, not of patentees; they were not patentees at the time, and, therefore, they are not entitled to refer to the loss or damage they suffered.

According to the learned judge, however, this is not the correct way to view the matter for the parts introduced by the Act of 1919, not being independent legislation but being inserted in an existing section by way of proviso, the same meaning must be given to the word "patentee" in this sub-section as in other sub-sections, namely, the successive patentees throughout the term of the patent. On that basis the judge assessed the loss, but it appeared on examining the matter fully, that the loss due to the patentee as such could not be said to be more than about one year's loss of royalties, for which reason the patent was extended by that term.

The second patent in question was that to Coleman, No. 26,722/06, relating to means for preventing wheel tires from skidding by making parts of the tire of one degree of hardness, and parts of the tire of another degree of hardness, for example, by means of blocks of rubber of different hardness arranged on the treads and vulcanised into the body of the tire. The facts were much more simple than in the case referred to above, the Crown not objecting to an extension for three years. After considering the matter and hearing the arguments, the judge decided to grant an extension of three years and six calendar months.

## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

GASEOUS FLUID EJECTOR.

Sir,—The two theories developed in my article which appeared in your issues of the 20th and 27th October last do not appear to be fully understood. The letter of "Interested," in your issue of November 10th, indicates that the writer has failed to grasp the essential differences between "depression" and "induction." They are two separate and distinct phenomena, and can be used independently of each other. My object in advancing the theories, both based on fundamental and undisputed facts, was to replace existing empirical formulæ by more exact expressions. To be of use to the designer, all theoretical expressions must be corrected by experimental factors, but if the theory is sound, the expressions may be used for forecasting improvements in design, and not merely to make a similar piece of apparatus larger or smaller in dimensions. The depression equation is either right or wrong in theory; it cannot be partly new and partly old. It is a distinct expression. The example quoted by me was for the purpose of demonstrating that a variation in $p_3$ is entailed by a range in $p_0$. It is not possible to fix a value of $p_3$ and assume that any arbitrary $p_0$ will maintain that depression. At the foot of column 2 on page 401, I specifically mention that constant volume cooling is excluded from the analysis. It is quite feasible to depress $p_3$ below its kinetic value by cooling the operating steam by the inductate. The correction involves complicated assumptions, and in view of the extreme variability of the mixture ratio of the inductate, was not proceeded with.

The depression equation, like all others, needs to be used in conjunction with experimental coefficients. I assumed an arbitrary value of 1.1 to suit my purpose. If a value of 0.8 had been taken, $p_0$ would approach the value quoted by "Interested." I might be pardoned for assuming that his value of $w$ from his mass equation was altogether wrong if I had no knowledge of his experimental factor. The depression equation indicates that a critical value of $p_0$ exists for every value of $p_3$ for a given ejector, whether high or low pressure. It might be mentioned that all heat-work types of apparatus are more efficient with higher initial pressures. It is not confined to kinetic flow devices. The figure of 1.5in. vacuum maintained in an air-free system is not remarkable. If no air is present, no ejector is required. The vacuum can be maintained by condensation so long as the condensed water is pumped up to the back pressure. The ejector would merely be operating against its own depression, which could be higher than the condenser vacuum pressure.

"Interested" states that the depression equation has no practical value, and goes on to state that for multi-stage ejectors, it is necessary to decide on the inter-stage pressures. How does he do that? The depression equation determines those pressures. Suppose that $p_0 = 80$ lb. per square inch absolute, $p_1$ is 14.7 lb., $n = 1.135$, $a$ is, say, 0.8 for the low-pressure type obtained by experiment. Then the depression pressure $p_3$ is 3.0 lb. per square inch in stage II. Allow a drop of 1.0 lb. into the jet, and the inter-stage pressure may be 4.0 lb. per square inch absolute. Experience may show that a drop of 1.0 lb. is too high. I am indicating the method only. The back pressure for stage I. is therefore 4.0 lb. per square inch. Using the same values as before, the depression in stage I. jet would be 0.35 lb. per square inch, and if a drop of 0.65 lb. is sufficient from the condenser into the jet, a condenser vacuum of 1.0 lb. per square inch can easily be maintained. If the air leakage is lessened, the vacuum pressure will fall to near the vapour temperature. Similar calculations would show that three stages would be necessary for steam pressures below 25 lb. per square inch of operating steam. I am open to any correction on experimental factors; that is only right and reasonable, but the theory is maintained to be correct.

My expression (2.2) was not developed in the article beyond the velocity stage. It can be presented in various ways to suit one's particular liking. Stated in terms of pressures, it is—

$$m = \frac{\left(\frac{p_0}{p_2}\right)^{\frac{n-1}{n}} - 1}{\left(\frac{p_1}{p_2}\right)^{\frac{m-1}{m}} - 1} \times A - 1$$

where $A = K C \beta \left(\frac{n}{n-1}\right)\left(\frac{m-1}{m}\right)$.

Where $n$ = index of expansion.
$m$ = index of compression.
$\beta$ = experimental coefficient.
K = nozzle coefficient.
C = compression efficiency.

Using a value of $n = 1.135$, $m = 1.06$, C = 0.48, K = .95, $p_0 = 105$, and other values as given by "Interested," except that $\beta = 0.9$, $m$ has a value of 0.1 lb. air per pound of steam. The variation in $\beta$ is not so large as the variation of his $a$.

The expressions are similar in form, but his is wrong as regards the index $n$ for $p_1$ and $p_3$ in the denominator. This, no doubt, explains the presence of the square root. I do not know how the expression is derived, but I fear that it is a quasi-empirical one of the type referred to in my article, especially in view of the low values of his correction factor $a$.

Surely "Interested" cannot be serious in stating that the expression for $w$ gives a minimum value of $p_0$ for a given $p_3$ when $w$ is zero. Analytical manipulation must be carried out on the theoretical expressions. Then the expression within the root brackets must equal unity or $p_0 = p_1$, and then $w$ equals zero, because no work is being done. $w$ (my $m$) can only be zero in other cases when the compression work of the operating steam absorbs all of the available expansion work.

I reiterate that depression and induction are separable; the former gives the pressure ratios, the latter the mass ratios.

It was not possible in the confines of a short exposition to discuss various implications in full. Suppose that I leave the steam ejector for a while, and examine the relationship of $p_0$ and $p_3$ for a pure gas ejector. The state point $p_0$ may be moved along the $p_0$ abscissa to any desired temperature $T_0$. That is to say, the available work above the back pressure line $p_3$ may be made any arbitrary amount. The depression equation shows that this is attended by no variation in $p_3$. It is constant. The back pressure line $p_3$ must be the mean effective pressure line. Equation (4) for mass induction shows clearly that $m$ may be increased because of the increased ratio of $T_1$ to $T_3$, quite independently of the depression equation; $m$ would be constant for all values of $T_0$ if no cooling were introduced.

It is maintained that my first conclusion is correct in theory, and consequently in practice, and appropriate values of $a$ for varying values of $x$ for single and multiple-stage ejectors would demonstrate this. It is hoped to obtain a series of curves for use with the two relationships for depression and mass induction. The statement that only a definite amount of air can be handled by a pound of steam under given $p_0$, $p_1$ and $p_3$ conditions is merely elementary theory, and can be left at that.

A reference to current advertisements will discover statements that the vacuum is unaffected by a given range in operating steam pressure. Since $p_0$ must vary, what may possibly occur is that the designed inductate drop into the jet $(P - p_3)$ for normal working is such that if $p_3$ should rise, the lessened drop is still sufficient to maintain the constancy of P and enable the ejector to remain stable. This may be bad in theory, but excellent practice. Reconciliation is the art of the designer.

I am pleased that "Interested" agrees with me that more efficient compression will lead to better air-handling capacity per pound of steam. It is refreshing to get away from the frictional entrainment theory. Some time ago I witnessed a test of a two-stage ejector, in which $p_0$ was 150 lb. per square inch, and the condenser and inter-stage pressures were 98 and 82 per cent. respectively of the barometric height. The depression equation with $a = 1.1$ gave close agreement to those figures, but it is not claimed that $a$ would be the same for a single-stage ejector, as stated above.

Seeing that "Interested" has challenged the accuracy of the depression equation, as stated it is further extended below by including as a factor the dryness fraction S of the steam at the end of expansion. It was intended to leave the expression in a simple form and correct by experimental values of $a$. Then—

$$p_0 = a.p_3 \left[\frac{K\left\{n + (x-1)(n-1)S.\right\}}{K.n. - S(n-1)(x-1)(1-K)}\right]^{\frac{n}{n-1}}$$

where the symbols have the same meaning as before.

Let $a$ = unity.
$p_3 = 2.5$ lb. per square inch abs.
$n = 1.135$ for steam initially dry.
S = 0.83 at end of expansion.
K = 0.90.

The expression gives $p_0 = 108$ lb. per square inch absolute, or 93 lb. gauge.

If $a = 0.97$, $p_0 = 90$ lb. per square inch gauge, and agrees with his practical value.

Henry A. Hepburn.

Birmingham, November 11th.

HIGH COMPRESSION IN PETROL ENGINES.

Sir,—In the report you give in your current issue, page 492, of Mr. Ricardo's remarks, he is made apparently to make two contrary statements. He says that in an engine under test detonation with a drop in power and efficiency occurred at a little above 100 lb. compression. A few lines farther on, he appears to say that a smaller cylinder can carry a higher compression without this occurring, and therefore proceeds to state the economy which results by raising the compression still higher.

I presume that "detonation" is a consequence of the physical properties of the working fluid, and should therefore occur just as much in a small as in a large cylinder, whilst if this is so the economies due to higher compression cannot be realised, and, on the other hand, if possible to carry higher compression on small cylinders than on large, then it would appear that at any given speed the power we can get from petrol is limited, being limited by the bore and stroke of the cylinder with the limit of compression pressure for the size of cylinder. Is this correct in Mr. Ricardo's opinion?

If I correctly understand the term "detonation," is it not possible that this always occurs to a greater or less extent in all engine cylinders having any serious compression pressures? By the analogy of other explosives, using the term in its popular sense, may not part of the result of this phenomenon be due to want of synchronism between the cycle of the piston and the explosion wave or to a harmonic of either?

If this suggestion is well founded, then it would appear that if detonation occurs in any given size of cylinder at a definite pressure, then loss of "power" could be obviated by changing the speed of the engine, making it, say, twice or treble the original speed. This may, of course, be practically impossible, and does not affect the thermal losses resulting.

Thus, it might be possible to work an engine with gunpowder—it has been done—but not with blasting gelatine. In this connection, my suggestion above would result in a petrol engine being designed on the same basic principle as Mr. Constantinesco's rock drill worked by sound waves. Your recent description of the system of wave power transmission is suggestive.

Angmering, November 12th. Geo. T. Pardoe.

It has been suggested that an aerial ropeway should be erected in Calcutta, at a cost of £16,000, for the removal of the city's refuse.

An all-India exhibition of Indian arts, industries and indigenous products, organised by the Industrial Exhibition Syndicate, which has the support of an influential committee, representing European and Indian interests, will be held in Calcutta in December.

At the recent meeting of the South Indian Railway Company the chairman said the Indo-Ceylon train ferry was, for the first time in its history, practically self-supporting. An important work that needed to be undertaken was the Chord line from Panruti to Trichinopoly. The line would be 95 miles in length, and would cost 200 lakhs of rupees.

The Corporation of Calcutta is embarking on a scheme for providing a large supply of water in the City. The work will necessitate an expenditure of approximately 2½ crores of rupees. The maximum supply of filtered water in the city is, at present, 40 million gallons per day and 31 gallons of unfiltered water. The new scheme, which will take several years to complete, will provide for a total supply of 70 million gallons of filtered water and 50 million gallons of unfiltered water. Altogether 23 miles of mains, ranging from 30in. to 60in. in diameter, will be laid.

## Railway Matters.

DURING a dense fog on Monday morning last a passenger train on the London, Brighton and South Coast Railway was derailed at Windmill Bridge Junction, Croydon.

THE terms for the absorption by the London and North-Western Railway Company of the North London Railway, the Shropshire Union Railways and Canal, and the Dearne Valley Railway have now been agreed.

THE Chicago, Rock Island and Pacific Railway Company has just suitably celebrated the opening of its first section—between Chicago and Joliet—on October 18th, 1852. Among the guests of honour was a woman who was one of the passengers by the first train.

ALTHOUGH the parent companies—the London and North-Western and the Great Central—had abolished them, second-class fares have been retained on the Manchester, South Junction and Altrincham Joint L.ne. They are, however, to be withdrawn at the end of the year.

FURTHER public meetings of proprietors and debenture holders in connection with the amalgamation and absorption of railways will be held next week. Among them will be those to approve the amalgamation of the London and North-Western, Midland, Furness, Glasgow and South-Western, and the Highland.

THE London, Brighton and South Coast Company's tank engine No. 333, of the 4–6–4 type, has been named by Colonel Billinton, the company's locomotive superintendent, "Remembrance," in memory of the 530 of its servants killed in the war. This engine is employed in the Victoria-Brighton express service.

WE regret to hear of the death last week of Mr. John Wilson, the late chief engineer of the Great Eastern Railway, who, among other important works on that railway, carried out the enlargement of the Liverpool-street terminus. He was the nephew of the well-known engineer, Edward Wilson, and his son, Mr. E. A. Wilson, is the present chief engineer of the Metropolitan Railway.

THE Transportation Act, 1920, authorised the Inter-State Commerce Commission to fix railway rates at such a scale as would bring to the companies a return of 6 per cent. Later, the Commission, quite within its rights, reduced the return to 5½ per cent. It is worthy of note, though that for the two years ended August 31st last the net operating income of the companies amounted to only 3.47 per cent.

A COMMISSION of experts is now engaged in studying the question of the electrification of the Pernik-Sofia line in order to intensify the exploitation of the coal mines, the most important in Bulgaria, and so help to meet the railways' requirements of coal. The construction is planned of an electrical power station at Pernik which will supply energy, not only to the Sofia-Pernik line, but also for lighting purposes in Sofia.

To prevent sand and dust rising from the track and causing inconvenience to passengers when crossing the desert east of Colton, in the State of California, the Southern Pacific tried an occasional spray of oil to the track. It did not prove effectual, as in a short time the oil was covered by sand and further sand and dust collected on it, to be blown up by passing trains. Trials are now being made with water sprinkled from the tender.

THE area in Chicago to be converted by the Illinois Central from steam operation to electric traction extends from the suburban terminus in Randolph-street to Matteson, a distance of 28 miles. There are lengths of six-track, four-track, three-track, and two-track, and two branches of double line of a total length of 9 miles. The track mileage to be converted is approximately 125. The main portion of the passenger working is to be completed by 1927, some portion of the freight working by 1930, and the remainder by 1935. Overhead construction with 1500-volt direct current is to be employed.

THE statement by Mr. Winston Churchill at the 1918 General Election as to the nationalisation of railways will be remembered. It is desirable therefore that it should be on record that speaking in Dundee on Monday night last he said: "I was formerly inclined to think that some enterprises might be run by the Government, and I argued that the railways, if all were combined together in one hand and managed from one point of view, would be better thus nationalised than if managed by different railway companies for the profit of the shareholders. But I must admit I have changed my views upon that point, and have changed my views as a result of experience."

AN instructive case was before the Manchester County Court on the 9th instant. The widow of a platelayer sued the London and North-Western Railway Company for the loss of her husband, who was knocked down and killed by a passenger train. The plaintiff claimed that no look-out man was employed, but from the evidence it appeared that the man, who was working with others on the down line, stepped out of the way of a down train on to the up line instead of, as laid down in Rule 273 (a), at once moving clear of all lines. As we read the report of the trial the claim was that there should have been a look-out man for the up line, but, in view of the above rule, his presence was quite unnecessary. Judgment was given for the railway company, but it will not affect the payment to the widow under the Workmen's Compensation Act.

ACCORDING to *Modern Transport*, the railways that will compose the North-Western, Midland and West Scottish Group are to be known as the London, Midland and Northern. Whilst it is fitting that the fine record of the Midland Railway should be perpetuated, and whilst a line that goes as far north as Wick may claim to be the "Northern Railway," we think that Midland and North-Western must commend itself more as being briefer and sufficiently comprehensive. Our contemporary further states that the Southern Group of railways is to be known as the Southern. The absence of the usual prefix "Great" is noticeable, but it does not rob the group of its main title nor impair its identity. As has already been observed in this column, the Eastern, North-Eastern and East Scottish Group is to be known as the London and North-Eastern. Under Section 3 of the Railway Act the Great Western retains its name.

## Notes and Memoranda.

THERE are still, according to the *Chemical Trades Journal*, large areas of platinum ores awaiting development in the Choco district of Colombia.

THE new X-ray department of the Manchester Royal Infirmary, which is said to possess the most powerful equipment in the country, is to be opened on the 18th inst.

FROM a preliminary account of a paper which is to be presented at the forthcoming meeting of the American Society of Mechanical Engineers, it appears that Mr. G. A. Orrock, of New York, advocates steam pressures as high as from 1200 lb. to 1500 lb. per square inch, but considers that temperatures above 750 deg. are not commercially practicable.

THE available stocks of zinc in all countries are estimated by Dr. J. Rubinfeld, of Berlin, at scarcely more than 75,000 metric tons; this amount is but one-half the available stocks a year ago. Production figures for 1913, 1920, and 1921 show a steady decline, and the doctor estimates that the zinc output of all countries during the current year will not exceed 390,000 metric tons.

IN the course of a recent lecture at the Finsbury Technical College, Professor Desch drew attention to the value of mineralogy and geology to the metallurgist, and the extreme importance of further work on refractory materials. The metallurgist must not, however, he said, attach too little value to the experience and knowledge of the foreman or skilled workman. For example, furnacemen could often judge temperatures in the neighbourhood of 1000 deg. with an accuracy within 20 deg.

IN the course of a Chadwick Public Leature, Professor Leonard Hill recently said that furnace and engine-rooms should be ventilated by fans at the bottom of wide trunks down which cool air naturally sinks, the fan breaking up the air into fine streams. Rooms are best ventilated by open windows or a system of fans to impel cool fresh air through gratings about 8ft. from the ground and extract it through apertures in the ceiling; floors and walls should be warmed by radiant heat from gas or coke fires.

THE Detroit City Gas Company uses steel turnings in place of wood shavings in its scrubbers. The tower used is situated after the primary condenser. It is 9ft. 6in. in diameter and 40ft. high. The shell contains two layers of steel turnings. The lower layer is 13ft. deep and the upper layer 10ft. deep. The top of the shell is equipped with sprays for putting hot water over the turnings to clean them. Below the lower layer there are sprays through which cold liquor may be pumped. Tests in August, 1922, showed that 85 per cent. of the total tar was removed. The differential pressure through the scrubber is from 3in. to 7in. of water.

DRYING cylinders are necessarily of light construction with little reserve of strength for the working pressures employed, and greater attention should be paid, says the Engineer Surveyor-in-Chief, Board of Trade, to the design and workmanship of the longitudinal seams. These seams should be of sufficient strength independently of the soldering, which should only be considered as a means of obtaining steam tightness and nothing more. Solder has little strength in itself, and is, moreover, liable to deterioration, and to become detached through the vibration and panting of a badly designed or corroded seam. A reliable steam gauge and adequate reducing and safety valves in the supply pipes are absolutely essential for safe working.

AMONG the minerals in the Tete district of South Africa of which indications have been found are magnetite, wolfram, galena, tin, mica, graphite, corundum and coal, and it is stated that petroleum has been found close to the Anglo-Portuguese border on the telegraph route at Kombezi. Magnetite is present along the Revugo River in segregated masses varying in size from small grains to huge blocks, and between Macassa and Chitakli, near the borders of the two prazos, Mitondu and Inhamotupico, close to the river Inyamadzi. Wolfram has been sent from the Kakanga copper mine. Galena is found in the old workings in the same neighbourhood. Tin has been discovered on the Portuguese side of the Luangwa, and mica is plentiful in the Macanga prazo.

ACCORDING to the *Commonwealth Engineer*, the N.S.W. Minister for Public Works has endorsed the necessity for a Commission to control the generation of electric power within the State. The question of introducing legislation to create an Electricity Commission is now under consideration. It is expected that the first work to be taken in hand will be the development of the hydro-electric resources of the State. A number of schemes have been investigated by the Public Works Department, but as the State is not richly endowed with extensive water-power resources near the centres of population, the question of establishing steam-driven plants in proximity to the coal mines will naturally receive early attention. Ample scope exists for the proposed Commission in developing the State's power resources on the most economical lines.

GERMANY'S greatest user of coal is the Federal Railway, which formerly was able to utilise only 55 to 70 per cent. of its combustible material, the remainder (cinder and ashes) having been regarded as worthless. In order to make use of this waste, which is said to contain 50 per cent. or more combustible material, about two years ago the railway adopted the Meguin system of recovering coal from ashes. According to a report by the United States Consul at Frankfort-on-Main, thirteen large works, with a capacity for handling 420,000 tons of cinders and ashes annually, are now in operation or under construction. The amount of pure coke obtained is estimated at 164,000 tons, with an average calorific value of 5500 units, compared with 7000 units for good hard coal. The fine coke, with the addition of fine coal and hard pitch, is used in making briquettes, about 74,000 tons of coke briquettes being thus obtained, with a calorific value of 6500 units. In addition to this, 256,000 tons of non-combustible clean slag are obtained; this serves for the manufacture of 130,000,000 slag stones, which are employed in building and possess the good qualities of both brick and "schwemmstein" (a kind of sandstone).

## Miscellanea.

A BED of lignite, about 133ft. thick, and covering an area of some nine square miles, is said to have been discovered near Ferrol, Spain.

THE total production of bituminous coal in the United States during the week ending October 14th was 10,021,000 short tons, and of anthracite 2,075,000 tons.

IT is proposed to construct a hydro-electric plant on the east branch of Bear River, Nova Scotia, at an approximate cost of 11,150,000 dollars, which would supply the north shore of Nova Scotia from Yarmouth to Middleton.

AT a recent meeting of the Electrical Development Association, Mr. Robinson said that arrangements were being made in Hackney for connecting the street coffee stalls with lamp-posts, so that they might draw a supply of electricity for cooking purposes.

THE contractor who is destroying the Vindictive has handed over to the town of Ostend the bow and other portions of the cruiser, which are to form part of a monument to be erected in commemoration of the blocking of Zeebrugge and Ostend by the British Fleet.

THE call of the Cunard Company's eastbound boats at Plymouth to leave mails, mentioned in this column on September 22nd last, was inaugurated on Sunday on the arrival of the Mauretania, which had crossed the Atlantic at an average speed of 24.47 knots, and thus established a record.

THE conditions in New Zealand are such, according to Mr. F. W. Harbord, that a blast-furnace and modern steel plant are not at present feasible, but if power, coke, coal and limestone were obtainable at reasonable prices, small quantities of pig iron and steel might be produced to meet local requirements partially for the time being.

THE opinion of a Committee of the Federated American Engineering Societies, which has completed an inquiry into the shift system of labour, is that American steel industries are in a position to change over from the present twelve-hour labour day to one of eight hours without materially increasing the cost of labour in their output costs.

THE tablet which has been erected in memory of the 232 members and students of the Royal Institute of British Architects, who laid down their lives in the Great War, will be unveiled by the Earl of Crawford and Balcarres, Honorary Fellow of the R.I.B.A., on Monday, November 20th, at 3 p.m. The tablet was designed by Mr. Trenwith Wills, A.R.I.B.A.

THE Department of Overseas Trade has just issued a report on the conditions and prospects of British trade in India, during the fiscal year April 1st, 1921, to March 31st, 1922, revised to September, 1922, by Mr. Thomas M. Ainscough, H.M. Senior Trade Commissioner in India and Ceylon. This report is obtainable at a price of 2s. 8½d. post free from his Majesty's Stationery Office.

WORK has been started on the proposed hydro-electric works at Imatra, Finland, which will use the water power of the Upper Vuoksen, and will yield 392,000 horse-power. The work is being undertaken under the auspices of the State Hydro-Electric Committee, and this first instalment, which will represent 70,000 turbine horse-power, is expected to involve an expenditure of 161,000,000 Finnish marks.

THE Leconte de l'Isle, a vessel of 11,000 tons, has recently been launched at La Ciotat. The new ship, which will be placed on the Marseilles-Madagascar-Réunion line of the contract services "Etat Messageries Maritimes," is 144.50 m. long, 15.60 broad and 12.35 deep. It will be fitted with two sets of engines of 3000 horse-power each, and will carry 80 first-class passengers, 70 second-class and 700 third-class.

THE exports of iron and steel from Spain during 1921 were of little volume, amounting to only 3686 metric tons, including pig iron and scrap, as compared with 24,921 tons in 1920 and 13,025 tons in 1919. That country imported 266,491 metric tons of iron and steel in 1921, a gain over the preceding year of 51 per cent., and of 220 per cent. over 1919. Belgium furnished by far the largest volume of the imports of iron and steel in 1921.

THE French Minister of Agriculture, announces in the *Matin* that the sum of 1,200,000,000 francs is to be placed at the disposal of agriculture to carry out the programme of supplying rural districts with electricity. The State, he says, will agree to grant a thirty-year loan, totalling 600,000,000 francs, at 4 per cent., to the Office National de Crédit Agricole and agricultural syndicates, as well as to communes, subject to their furnishing the remaining 600,000,000 francs.

PROSPECTING in the Newcastle area of South Africa is reported in the *South Africa Mining and Engineering Journal*, to have disclosed up a 12ft. seam of cannel coal, the lower 6ft. of which yields 28 gallons of crude oil to the ton. A seam of coking coal on the same property is of exceptionally fine quality, and is said to equal the best coking coal produced in South Africa. Above all it is only a few miles from the blast-furnaces of the Newcastle Iron and Steel Works.

THE monthly report of the National Federation of Iron and Steel Manufacturers states that the production of pig iron in October amounted to 481,500 tons, and of steel ingots and castings to 565,200 tons. Although the production of pig iron was the highest since the coal stoppage, it is still only 50 per cent. of the average monthly production of 1913. Included in the production of pig iron were 129,900 tons of hematite, 151,100 tons of basic, 134,000 tons of foundry and 31,500 tons of forge pig iron.

IT is reported that the South Australian Premier intends to consult the Cabinet with regard to securing expert opinion on the advisability of establishing a new port at the mouth of the river Murray, at Goolwa or Victoria Harbour. The Government is definitely of opinion that the project should be undertaken owing to the fact that it will avert duplication of the present railway over the hills. The estimated cost, including breakwater and jetty extensions, extra railway facilities, and a canal from Goolwa to Victoria Harbour, is estimated at approximately £1,000,000.

# ELECTRICAL EQUIPMENT FOR A SCHERBIUS ROLLING MILL

THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, RUGBY, ENGINEERS

(*For description see page* 516)

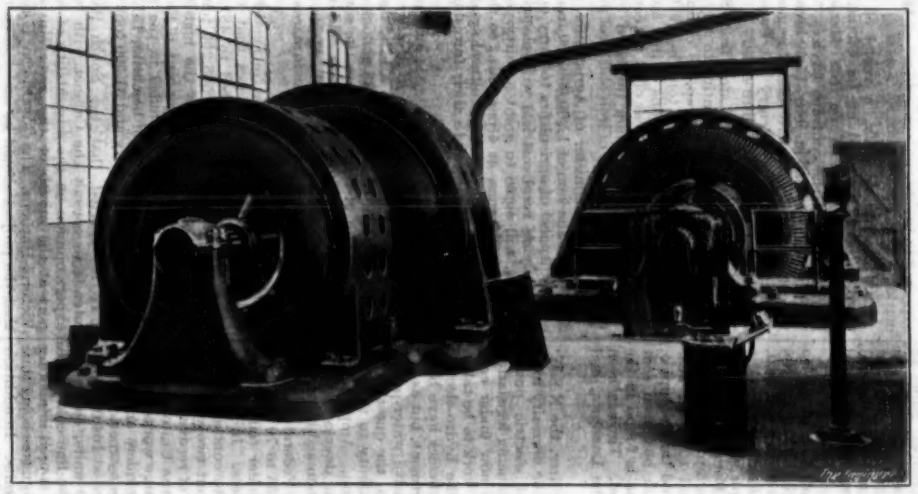


FIG. 9—MERCHANT MILL—MAIN MOTOR AND REGULATING SET

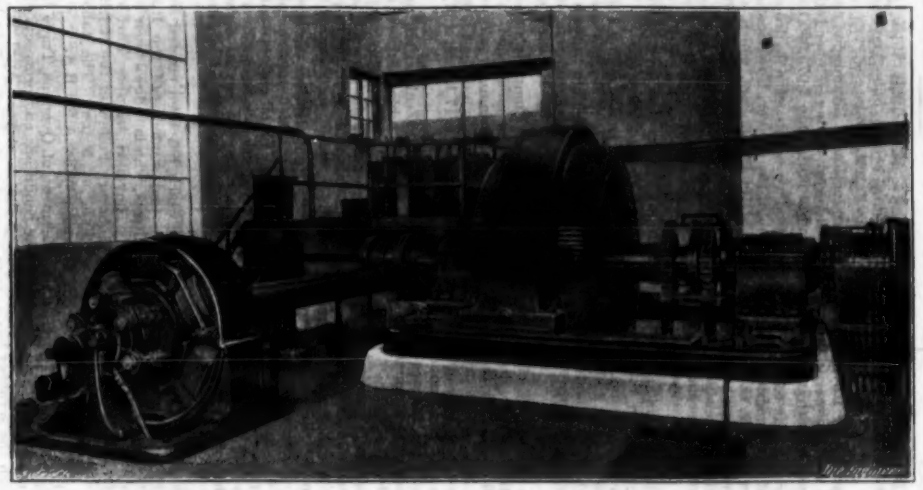


FIG. 10—ROUGHING MILL—MAIN MOTOR AND INTERMEDIATE EDGING ROLL MOTOR

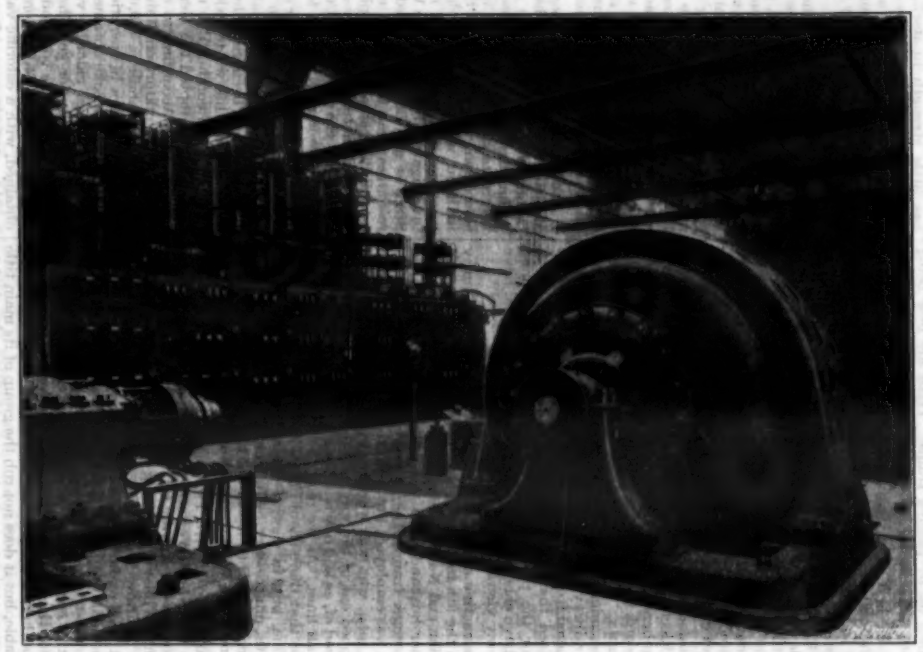


FIG. 11—MERCHANT MILL—MOTOR HOUSE, SHOWING REGULATING SET AND CONTACTOR GEAR

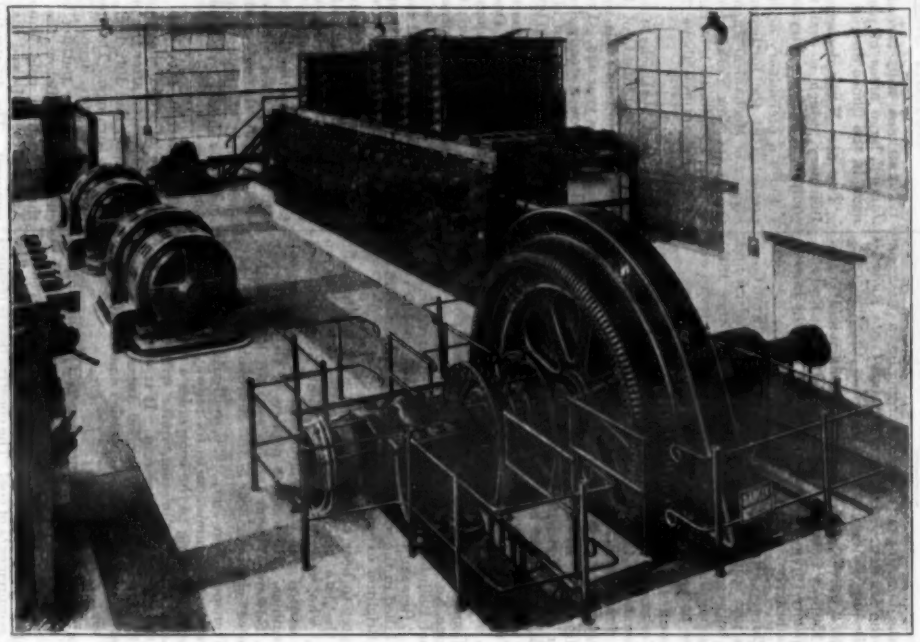


FIG. 12—FINISHING MILL—MOTOR, CONTACTOR PANELS, AND REGULATING MACHINES

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*Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of* The Engineer.

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*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*By arrangement with Reuter's Engineering Service,* **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*


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### DEATH.

On November 14th, 1922, as a result of being knocked down by a motor car, Mr. J. B. Humphreys, director and manager of Ferguson Superheaters, Limited, with whom he had been associated for many years.

# THE ENGINEER.

*NOVEMBER* 17, 1922.

### The Propulsion of Submarines.

To many people, no doubt, the news that a fatal explosion had occurred on board submarine K 26 at Chatham Dockyard on November 3rd was the first intimation that a steam-driven submarine vessel is being constructed for the Royal Navy. The boat in question belongs to the famous "K" class, and is one of a number of vessels of war which had been laid down prior to the Armistice, and whose completion was decided upon for special reasons. The K 26 was begun by Vickers in July, 1918, launched in August of the following year, and towed to Chatham for completion. At the time of the accident she was being prepared for trial. According to the evidence given at the inquest on November 6th, the safety valves were being tested, when a large escape of steam took place, filling the machinery compartments with dense clouds of steam, smoke and soot. Two men in the boiler-room were so badly scalded that both succumbed to their injuries. An inspector of fitters, giving evidence, explained that the steam from the boilers, which had reached a pressure of over 200 lb., rebounded against the bottom of the waste steam pipe, and was forced through the furnace into the boiler-room. The waste steam pipe was of a special design, necessitated through lack of space on board submarines, but the shape of that pipe was to be modified. Such an accident, he added, was impossible in any other type of ship. The authorities were satisfied that the valves were in working order. Fortunately, the oil sprays were not burning at the time. Engineer-Commander Mitchell, another witness, explained that before a submarine of the "K" type dived while at sea, the order, "Prepare to dive," indicated to the men in the boiler-room that they must leave it at once to avoid an accident similar in some respects to the present one. Before submersion took place the doors covering the funnels were closed.

The "K" class submarines have no parallel, either among British submarines or among the underwater boats of the world. They were designed for the special purpose of accompanying the battle fleet on its war cruises and acting in tactical co-operation with it. For that purpose it was necessary to endow them with good sea-keeping qualities and high speed, and the latter requirement involved the use of steam engines in place of the internal combustion motor usually fitted in submarine vessels. Since the war this class has been exposed to a good deal of criticism, but the fact remains that within the limited scope of duties they were intended to fulfil the boats were reasonably successful. Their actual value in the fighting line was never tested, as no major fleet engagement was fought after they came into service. The peculiar features of the design were ventilated in the Press nearly two years, when K 5 foundered with all hands in the Western Approaches while exercising with the Fleet. On that occasion Rear-Admiral S. S. Hall—who had been Commodore of Submarines during the war and could therefore speak with high authority—described the class as "freak" submarines, and affirmed that they had always been a source of great anxiety in bad weather or in rapid diving. That was because of their great length and the structural complications due to the employment of steam, which necessitated large openings for funnels and air intakes to the boiler-rooms. Thorough training on the part of the *personnel* is essential to the safe handling of these boats. They have no fewer than five kinds of motive power for propulsion on and under water and for operating the complicated system of machinery with which they are fitted. To attain the designed surface speed of 24 knots, two sets of single-reduction turbines are installed, taking steam from two small-tube boilers with forced draught. When the boat is required to dive quickly or to get under way promptly after breaking surface, an 800 brake horse-power Diesel motor is called into play, and for navigation under water electro-motors are employed. Other machinery includes electric motors for lowering the funnels and closing water-tight hatches over the funnel openings; air compressors for charging air bottles and blowing ballast tanks; and hydraulic power for working the hydroplanes and raising the periscopes and telescopic masts. It is no wonder therefore that every "K" boat is known in the Navy as "a box of tricks." When commenting on the loss of K 5, Admiral Hall expressed surprise that any of the class had been kept in commission after the war. It was presumably done with the intention of perfecting their manœuvres with the battle fleet, "but," he added, "it appears to be a very questionable policy, since the class will be obsolete long before a fleet battle can take place. They were designed solely for the North Sea, and have not the qualifications nor the sea endurance to accompany a battle fleet under war conditions, except in home waters." The Admiralty, however, must have had good reasons for deciding to complete the K 26, although five sister boats unfinished at the Armistice were cancelled. That steam will ever be reverted to as the motive power of future British submarines is not very probable. For this type of vessel it has inherent drawbacks. So far as the British Navy is concerned, it was first tried in the Swordfish, a pre-war submarine which proved a failure, and it would certainly not have been re-introduced in the "K" class, but that the attainment of the very high speed aimed at was impracticable with Diesel engines. Our fastest boats—and indeed the swiftest submarines of any navy during the war—were those of the "J" class, fitted with three engines, each having twelve cylinders and developing a total of 3600 brake horse-power. In France, however, steam propulsion for submarines has been in vogue many years, and although the system is apparently being abandoned, several of the largest boats of her present-day navy are steam-driven. They are the Dupuy de Lôme, the Sané and the Gustave Zédé, with a surface displacement of approximately 850 tons. We understand that the French naval authorities are considering a project of replacing the steam machinery of these three submarines with Diesel engines taken from surrendered German boats. Should this decision be reached, it will not be easy to reconcile with the reports, lately published in France, of the remarkable success which has attended the performance of the Schneider-Carels Diesel motors installed in the large submarines, Néréide, Fulton, and Joessel, two of which are said to have exceeded their designed speed of 16½ knots by 1½ knots. Commenting recently on the development of the French submarine flotilla, the Paris *Temps* stated that the problem of manufacturing an entirely satisfactory motor for submarine use had at length been solved, and "we now possess a motor, entirely French in type, which is in no way inferior to the Diesel engines that made the fortune of the German fleet." The Commandant of Toulon naval station is quoted as having reported that the Néréide, Fulton and Joessel, equipped with the new French motor, leave nothing to be desired. In these circumstances, it is not clear why the motors of ex-German submarines should be used to re-

engine the French steam-driven boats which it is proposed to convert to Diesel drive.

When the war broke out, we in this country were admittedly behind Germany in the production of high-power Diesel motors suitable for submarines, and so long as the struggle continued there was no opportunity to develop an engine capable of giving an output of power per cylinder equal to that of the German type. Germany's largest submarine engine developed 300 brake horse-power per cylinder, and the ordinary U boat engine 200 brake horse-power. As Mr. A. W. Johns has pointed out in a paper on German submarines, the necessity for quick production of engines in this country during the war prevented progress beyond the standard 100 brake horse-power per cylinder, though the obvious advantages, from the point of view of hull design, conferred by the reduced length of the larger cylinder engine for the same total power were clearly recognised by our designers. Since the war the Admiralty has been devoting much attention to the improvement of submarine motors, and notable progress is believed to have been made, though hampered of late by the reduced funds available for research and experimental work on behalf of the Navy. The features of the X 1, a submarine laid down at Chatham twelve months ago, have yet to be disclosed, but it is a safe presumption that she will be propelled by Diesel engines. Meanwhile, the impending trials of the K 26, the last of our steam-driven boats, will be watched with interest, though it would appear from the account of the explosion at Chatham that she is not free from the disabilities which have caused most of the other units of her class to be withdrawn from active service.

### Non-Metallic Enclosures in Steel.

THE presence in steel of non-metallic enclosures in varying quantities is a well-recognised fact. There is, however, a very wide difference of opinion with regard to them. Considered from the steel maker's aspect, the contention is put forward that in commercial steel the presence of these enclosures in considerable quantity is entirely unavoidable. But the engineer is bound to ask whether or not such enclosures are injurious to the service qualities of the steel in which—unavoidably or not—they are present. Here, as is usually the case, the whole matter must turn upon a question of degree. No doubt there is some justice in the steel maker's contention that the presence of non-metallic enclosures—or, as they are sometimes loosely termed, "slag enclosures"—is quite unavoidable. There are, at all events, few specimens of steel in which a certain number of such bodies is not to be found. There are, however, wide differences in the number and size of the enclosures which are met with in different samples of steel, and in view of the weakness and brittleness of the material of which these enclosures consist, there can be little doubt that if present in sufficient quantity they *must* be seriously injurious to the steel. The practical question then becomes, What is the limit in size and number of such enclosures which should be permitted?

The question put in this form constitutes a problem which does not appear to have been adequately faced by either steel makers or engineers. It is not at present possible to specify in any way the number, size, and distribution of enclosures present in a given grade of steel, and, correspondingly, although an engineer may feel satisfied that these enclosures are deleterious for steel used in some particular way, he cannot say at all definitely whether the steel which he considers unsatisfactory on this ground contains twice or ten times too many of such bodies. This is a vague condition, which seems to have been tolerably satisfactory up to the present time and up to a certain degree of efficiency, but there are serious signs that the end of this happy state of affairs is approaching. These signs take the form of statements to the effect that steels much freer from non-metallic enclosures can be and are supplied by foreign steel makers, and that these steels offer very considerable advantages from the point of view of the user. Both the fact itself and the inference may or may not be true, but it is very important, both to the British engineer and the British steel maker, to know whether they are true or not. A statement of that kind, even if it should be nothing more than a legend, is apt to weigh seriously in the minds of those who have to place orders for steel. It is, in fact, a challenge in regard to quality which is thrown out against the British steel maker, and it is one to which we feel sure, he will not be slow to respond. The real difficulty lies in arriving at a satisfactory and conclusive means of establishing the facts. The first step in deciding such a matter must obviously be to find some method of determining the relative amounts of non-metallic enclosures present in two or more samples of steel. The second, and perhaps the more difficult, step is to determine in some conclusive fashion what is the comparative service value, if a really substantial difference has been found. For the first step one would look, naturally, to the analytical chemist, but we fear that here he will not be able to help us very much. If the enclosures with which we have to reckon were entirely of the nature of sulphides, whether of manganese or iron, or both, a simple determination of the sulphur content of the steel would serve the purpose to some extent, although even then the size and distribution of the enclosures, which are so very important, would remain to be determined in other ways. But the actual enclosures consist of substances of a widely diversified kind. Sulphides play an important, but not an exclusive part. We find silicates and oxides of various kinds as well as sulphides, and the analytical determination of these substances is a matter of very great if not insurmountable difficulty. Thus, the "silicon" ordinarily determined in steel analysis includes both the silicon present in solid solution in the iron, and also at least a part, if not the whole of that contained in any silicate enclosures in the steel, and there is no very ready means of distinguishing between the two. We must, therefore, turn to the microscope as the only means of diagnosing the presence, amount and distribution of non-metallic enclosures. A great deal of research has been devoted to this subject, so that at the present time expert metallurgists are well able to distinguish the various kinds of enclosures found in steel. What is wanted for the present purpose, however, is a development in a quantitative direction which will enable the microscopist to determine the amount of the enclosures present. An estimate, based upon the judgment of the individual observer can, of course, be obtained at present, but it is not in itself sufficiently convincing. If, however, the demand for a more or less quantitative method arises, we feel sure such a method will soon be forthcoming. For instance, it should be possible to adopt a specimen or section of standard area and to determine upon it the size of the largest enclosure present and the number per unit area above a certain minimum size. Given such data, a comparison between different makes of steel would be possible. Nor need such a method be regarded as revolutionary; it is merely an adaptation of the microscope to what is a special kind of analytical determination. Individual judgment can here be almost entirely eliminated, and mere prejudice against an apparently new method should not blind either steel maker or user to its very real potentialities. The modern tendency to inquire more and more closely into the inner nature and constitution of our materials cannot be checked, however much any individual may regret the "good old days" when a simple bending or tensile test was the beginning and end of specified requirements. Moreover, the maker of a sound product has everything to gain and nothing to lose by the modern methods, and in that spirit advances in this direction should be welcomed by British steel makers. Their products should assuredly fear no comparison, however searching, with those of other countries.

From this point of view, however, the second step to which we referred above—that of determining the importance or otherwise of non-metallic enclosures—becomes of vital interest. It is likely to be found that various steels differ widely in regard to enclousres. This information is of little value until it is shown that the steel which appears to be worse as regards enclosures is also worse as regards practical service value. A good deal of evidence has, of course, already been accumulated, tending to show that enclosures, when unduly large or numerous, tend to weaken the steel, but it is quite another matter to determine at what point this influence makes itself felt sufficiently to warrant the extra care and expense which may be involved in avoiding enclosures. This is, admittedly, a difficult matter. Some light can be thrown on the subject by systematic and exhaustive testing—the tests applied including not only bending and impact tests, but also tests in which the steel is subjected to hardening and tempering, as in the case of spring steels. Information of this kind would go a long way towards satisfying the minds of steel users on this point, but the ultimate test upon which the settlement of the whole question must depend is that of service. If grades of steel known to be approximately free from enclosures are found in the long run to give better service than grades which are less "clean," then no doubt will be left; on the other hand, it may be found that in practical service the enclosures, unless quite excessive, are a mere bogey, and that their elimination is an unnecessary refinement. But whichever conclusion may ultimately be reached, it remains equally important that the necessary facts should be obtained and studied.

### Railway Working in Fog.

For a good deal of the chaos which has been experienced on the railways in the London area this week there is now but little excuse. As we have remarked on the several previous occasions when we have mentioned this matter, the delays do not originate in any trouble the drivers experience whilst running. The remarkable sagacity and intuition with which our drivers are blessed enable them, with the assistance of the fog signalmen, to run between stations in fog almost as well as they do at night. It is in the station yards that the delays originate and accumulate. A train or a light engine arrives at the home signal outside a busy yard, but the signalman cannot see it. He knows it is coming, as he has given permission on the block instruments for its approach, but, unless he has a "train waiting" indicator, he cannot tell, amidst all the noise of other trains and engines, when it arrives and possibly he may not know into what road it wishes to enter. Under what is known as the "carriage working programme," this train on arrival forms another train out. Its late arrival on its inward journey means a late departure for the outward trip. A late departure, in turn, means a longer occupancy of a platform road, and that, again, delays arriving trains. Trains are further delayed because the signalman is unaware whether or not a platform road is clear. Each movement that is hindered not only delays that particular train or engine, but succeeding trains. Much of this inconvenience may now be avoided by the use in signal-boxes of illuminated diagrams, actuated by track circuits. They tell a signalman what lines are occupied, and to what extent, and what are free. They advise him, too, when the expected—also the unexpected—train or engine has arrived at his home signal, and when an outgoing train has passed and is clear. Trains could be got away more promptly from stations were telephones provided on each platform, near which a youth should stand who could act as an intermediary between the platform inspectors and the signal-box. An advantage that companies which have electrically operated trains experience is that there is no changing of engines. No longer has such a train to wait for its engine, nor an engine after arrival to wait for a road to the engine pit or turntable. Out on the line conditions could be improved and drivers still further helped. Where there is an ample supply of electricity, repeater signals of the type described in our issue of July 30th, 1920, as provided throughout the whole of the Underground, could be used, and drivers thus get an earlier intimation of the condition of the signals they were approaching. The biggest boon for enginemen would, however, be the provision of automatic train control, as then they could run with confidence, knowing that were danger ahead they would automatically be pulled up. It must be borne in mind that estimates furnished by the railway companies to Colonel Pringle's Committee on this subject showed that £100,000 a year could be saved on fog-signalling expenses by the adoption of automatic train control.

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IN commenting on the explosion of a water-tube boiler in Newcastle-on-Tyne, the Engineer Surveyor-in-Chief, Board of Trade, says: "This boiler, although in almost constant use, was not opened up for cleaning and inspection for a period of about eight months, and the accumulation of sediment and scale was such apparently as to impair the reliability of the glass water gauges, and therefore to increase unduly the risk of overheating. The wasted condition of the tube that failed through overheating when the boiler pressure was very much lower than the ordinary working pressure indicates that greater care should be exercised to ascertain the actual state of the tubes and to ensure that the boiler is maintained in a safe condition. Having regard to the uncertainty as to whether the whistle of the high and low water alarm gave warning that the water level in the boiler was too high or too low, it is thought that the alarm might with advantage be modified to give a different and unmistakable warning in each case. This explosion is illustrative of the necessity for the systematic cleaning and inspection of boilers of this type at short intervals; these are matters of first importance which should not be subordinated to any other consideration."

# TRANSPORT COSTS PER TON-MILE.

*[Contributed.]*

THE following table hardly calls for any explanation, but in some respects it invites comments. As regards the fifteen items marked with a capital A, there can be little or no question, since they are based on proved figures. Those marked B are practically in the same position, but those marked C—over half the total number—are based on estimates which will not pass unchallenged. We have indicated one such example by a footnote. We understand that very wealthy people do change their cars once a year, and are content in the case of a Rolls-Royce to sacrifice £1000 in so doing. But a careful man may keep such a car for ten years and then sell it for £500, thus reducing the annual capital cost from £1000 to £150. The other items under this heading may be a little, but not much, on the high side. It is interesting to note that if we reduce the cost of running a Rolls-Royce car to £700 per year, its position in the table of cost and speed per ton-mile falls immediately after the modest Horse and Trap! Many other interesting facts may be discovered by a careful examination of the table. Note, for example, that a hand-barrow is more costly per ton-mile than a London–Paris aeroplane, and that, according to an estimate by Commander Burney, the cost per ton-mile by rigid airship is only one-seventh of that by commercial motor cycle and side car! Another item which gives food for thought is No. 30. It will be seen that his Majesty's Mail spends 132d. per ton-mile for the carriage of letters. On turning to items 17 and 18, it will be seen that parcels can be carried for 17d. per mile. The whole philosophy of the problem of terminal charges is embraced in these relative figures.—ED. THE E.

## ANALYSIS OF COSTS.

No. 1.—BARGE:—First cost, £300. At 20 years' life (complete write-off), £15 per year. Crew and horse, £200. Etc., £20. 15 miles per day for 300 days per year. Load, 150 tons.
No. 2.—TRAMP STEAMER:—As per published figures.
No. 3.—ELECTRIC GOODS TRAIN:—As per published figures.
No. 4.—STEAM GOODS TRAIN:—As per published figures.
No. 5.—FORD VAN:—First cost, £160. At 1 year's life (sale value), £80 per year. Petrol and oil, £200. Tire, £30. Garage, £40. Etc., £10. 100 miles per day for 300 days per year. Load, 0.050 ton.
No. 6.—LONDON MOTOR OMNIBUS:—As per published figures.
No. 7.—LEYLAND 3-TON LORRY:—First cost, £1000. At 6½ years' life (complete write-off), £150 per year. Petrol and oil, £350. Man, £200. Tires, £40. Garage, £50. Etc., £10. 50 miles per day for 300 days per year. Load 3 tons.
No. 8.—ELECTRIC PASSENGER TRAIN (3RD CLASS):—As per published figures.
No. 9.—AIRSHIP (RIGID):—As per Commander Burney's figures.
No. 10.—PEDAL BICYCLE (PLEASURE):—First cost, £15. At 3 years' life (complete write-off), £5. Tires, £2. Repairs, £1. Etc., £1. 15 miles per day for 300 days per year. Load, 0.09 ton.
No. 11.—STEAM PASSENGER TRAIN (3RD CLASS):—As per published figures.
No. 12.—FORD TOURING CAR:—First cost, £160. At 1 year's life (sale value), £80 per year. Petrol and oil, £140. Tires, £20. Garage, £10. Etc., £10. 50 miles per day for 300 days per year. Load, 0.50 ton. Owner driven.
No. 13.—ELECTRIC PASSENGER TRAIN (1ST CLASS):—As per published figures.
No. 14.—AEROPLANE ("£ s. d. of FLYING"):—As per estimate in the book entitled "£ s. d. of Flying."
No. 15.—STEAM PASSENGER TRAIN (1ST CLASS):—As per published figures.
No. 16.—MOTOR CYCLE AND SIDECAR (PLEASURE):—First cost, £160. At 1 year's life (sale value), £80 per year. Petrol and oil, £40. Tires, £7. Etc., £5. 40 miles per day for 300 days per year. Load, 0.18 ton. Owner driven.
No. 17.—G.P.O. PARCEL POST (INLAND):—As per published figures.
No. 18.—G.P.O. PARCEL POST (FOREIGN):—As per published figures.
No. 19.—AIRSHIP (RIGID):—As per Air-Commodore Maitland's figures, 1919.
No. 20.—COOLIE, B.E. AFRICA:—Man, £12. 20 miles per day for 300 days per year. Load, 0.02 ton.
No. 21.—LINER (3RD CLASS):—As per steamer companies' charges.
No. 22.—MOTOR CYCLE AND SIDECAR (COMMERCIAL OWNER DRIVEN):—First cost, £160. At 1 year's life (sale value), £80 per year. Petrol and oil, £40. Tires, £7. Etc., £5. 40 miles per day for 300 days per year. Load, 0.09 ton. Owner driven.
No. 23.—LONDON TAXI CAB:—As per published figures.
No. 24.—HORSE CARRYING LOAD:—First cost, £30. At 10 years' life (complete write-off), £3 per year. Food, £50.
No. 25.—PRIVATE PARCEL POST:—As per published figures.
No. 26.—LINER (1ST CLASS):—As per steamer companies' charges.
No. 27.—PRIVATE COMPANY'S AEROPLANE SERVICE (LONDON-PARIS PASSENGER):—As per published figures.
No. 28.—HAND BARROW:—First cost, £12. At 6 years' life (complete write-off), £2 per year. Man, £100. Etc., £1. 5 miles per day for 300 days per year. Load, 0.20 ton.
No. 29.—HORSE AND TRAP:—First cost, trap, £50. At 5 years' life (complete write-off), £10 per year. Horse, first cost, £30. At 10 years' life, £3 per year. Food, £50. Stable, £2. Man, £150. 30 miles per day for 300 days per year. Load, 0.07 ton.
No. 30.—G.P.O. LETTERS:—As per published figures.
No. 31.—PRIVATE COMPANY'S AEROPLANE SERVICE (LONDON-PARIS PARCELS):—As per published figures.
No. 32.—AEROPLANE:—As per Advisory Board of Civil Aviation, 1922.
No. 33.—CYCLE WITH CARRIER:—First cost, £15. At 1 year's life (sale value), £7 10s. per year. Etc., £2 10s. Man, £100. 25 miles per day for 300 days per year. Load, 0.018 ton.
No. 34.*—ROLLS-ROYCE CAR (WEALTHY MAN'S ESTABLISHMENT):—First cost, £2000. At 1 year's life (sale value), £1000 per year. Man, £300. Petrol and oil, £200. Garage, £30. Tax and insurance, £125. Tires, £60. Etc., £65. 20 miles per day for 300 days per year. Load, 0.30 ton.
No. 35.—U.S.A. AEROPLANE POSTAL SERVICE:—As per published figures.
No. 36.—JUNKER ALL-METAL MULTIPLE-ENGINED AEROPLANE:—First cost, £23,400. At 4 years' life (complete write-off), £5850 per year. Organisation, fuel, aerodromes, &c., £19,656. 36,000 miles per year. Load, 0.90 ton. NOTE.—The annual percentage of cost of machine to total costs in an ordinary machine is 50 per cent. to 50 per cent.; in this machine it is about 30 per cent. to 70 per cent., this being due to 4 years' life instead of 1 year's life, insurance being halved and the absence of sheds.
No. 37.—TWO-ENGINED PRESENT TYPE AEROPLANE:—First cost, £15,000. At 1 year's life (complete write-off), £15,000 per year. Organisation, fuel, aerodromes, &c., £15,000. 28,800 miles per year. Load, 0.90 ton.
No. 38.—AEROPLANE (M. BREGUET):—As per published figures in French Press, 1922.
No. 39.—AIRSHIP (RIGID):—First cost, £400,000. At 1 year's life (complete write-off), £400,000. Sheds, £53,300. Handling crews, £200,000. Mechanics, £30,000. Riggers, £30,000. Pilots, £6000. Petrol and oil, £6875. Insurance, £120,000. Offices, £4000. Management, £10,000. Aerodromes, £20,000. Car service, £4000. Gas and plant, £15,000. 1000 miles per day for 50 days per year. Load, 10.00 tons.
No. 40.—G.P.O. AEROPLANE SERVICE (CAIRO-BAGHDAD):—As per published figures.
No. 41.—PRIVATE COMPANY'S AEROPLANE SERVICE (LONDON-PARIS LETTERS):—As per published figures.
No. 42.—PRESENT TYPE FOUR-ENGINED AEROPLANE:—First cost, £20,000. At 1 year's life (complete write-off), £20,000 per year. Organisation, fuel, aerodromes, &c., £20,000. 36,000 miles per year. Load, 0.90 ton.
No. 43.—PRESENT TYPE SINGLE-ENGINED AEROPLANE:—First cost, £5000. At 1 year's life (complete write-off), £5000. Organisation, fuel, aerodromes, &c., £5000. 36,000 miles per year. Load, 0.18 ton.
No. 44.—A. V. ROE'S TRIPS BY AEROPLANE, 1919:—As per published charges.
No. 45.—R.A.F. IN ENGLAND:—Annual cost per squadron of 15 machines, £250,000 (official). Hours flown per machine per year, 300 hours. Load carried, 0.18 ton. (Minimum cost—max. flying hours).
No. 46.—POSTMAN:—Man, £200. 15 miles per day for 300 days per year. Load, 0.009 ton.
No. 47.—PRESENT TYPE AEROPLANE IN FLYING SCHOOL:—Ticket costs, £75. Flying takes place on 73 days per year, 20 per cent. of a year. Average time for taking ticket, 3 hours. Average speed, 70 miles per hour. Average load carried, 0.07 ton.
No. 48.—R.A.F. IN INDIA (AEROPLANE):—As per published figures.
No. 49.—R.A.F. AEROPLANE SERVICE (KENLEY-PARIS, 1919):—As per published figures.
No. 50.—R.A.F. IN ENGLAND:—Annual cost per squadron of 15 machines, £250,000 (official). Hours flown per machine per year, 100 hours. Load carried, 0.18 ton. (Maximum cost, ordinary flying hours).

## AVERAGE SPEEDS AND COSTS PER TON-MILE.

| No. | Ind. | Method. | Speed. | £ | Pence. |
|---|---|---|---|---|---|
| | | | m.p.h. | | |
| 1 | C | Barge | 1 | 0.0004 | 1/10 |
| 2 | A | Tramp steamer | 7½ | 0.0020 | ½ |
| 3 | A | Electric goods train | 25 | 0.0030 | ¾ |
| 4 | A | Steam goods train | 15 | 0.0040 | 1 |
| 5 | C | Ford van | 20 | 0.0140 | 3 |
| 6 | A | London motor omnibus | 10 | 0.0160 | 4 |
| 7 | C | Leyland 3-ton lorry | 8 | 0.0170 | 4 |
| 8 | A | Electric passenger train (3rd class) | 25 | 0.0180 | 4 |
| 9 | C | Airship (rigid), Commander Burney, 1922 | 80 | 0.0160 | 4 |
| 10 | C | Pedal bicycle (pleasure) | 7 | 0.0220 | 5 |
| 11 | A | Steam passenger train (3rd class) | 40 | 0.0240 | 6 |
| 12 | C | Ford touring car | 18 | 0.0350 | 8 |
| 13 | A | Electric passenger train (1st class) | 25 | 0.0380 | 9 |
| 14 | C | Aeroplane ("£ s. d. of Flying," 1918) | 100 | 0.0370 | 9 |
| 15 | A | Steam passenger train (1st class) | 40 | 0.0480 | 12 |
| 16 | C | Motor cycle and sidecar (pleasure) | 21 | 0.0600 | 14 |
| 17 | A | G.P.O. parcel post (inland) | 12 | 0.0700 | 17 |
| 18 | A | G.P.O. parcel post (foreign) | 15 | 0.0700 | 17 |
| 19 | C | Airship (rigid), Air-Commodore Maitland, 1919 | 60 | 0.0875 | 21 |
| 20 | C | Coolie, B.E. Africa | 2 | 0.0900 | 22 |
| 21 | A | Liner (3rd class) | 12 | 0.1000 | 24 |
| 22 | C | Motor cycle and sidecar (commercial owner driven) | 21 | 0.1200 | 29 |
| 23 | B | London taxi-cab | 14 | 0.1700 | 40 |
| 24 | C | Horse carrying load | 5 | 0.1700 | 41 |
| 25 | A | Private parcels post | 15 | 0.2000 | 48 |
| 26 | A | Liner (1st class) | 12 | 0.2200 | 53 |
| 27 | B | Private company's aeroplane service (London-Paris passenger) | 100 | 0.3300 | 80 |
| 28 | C | Hand barrow | 1½ | 0.3400 | 82 |
| 29 | C | Horse and trap | 6½ | 0.4000 | 96 |
| 30 | A | G.P.O. letters | 17 | 0.5500 | 132 |
| 31 | B | Private company's aeroplane service (London-Paris parcels) | 100 | 0.6000 | 144 |
| 32 | C | Aeroplane (Advisory Board for Civil Aviation), 1922 | 100 | 0.7000 | 168 |
| 33 | C | Cycle with carrier | 6 | 0.8100 | 195 |
| 34* | C | Rolls-Royce car (wealthy man's establishment) | 22 | 1.0000 | 240 |
| 35 | B | U.S.A. aeroplane postal service | 90 | 1.0000 | 240 |
| 36 | C | Junker all-metal multiple-engine aeroplane | 100 | 1.0100 | 243 |
| 37 | C | Two-engine present type aeroplane | 80 | 1.5400 | 370 |
| 38 | C | Aeroplane (M. Breguet, 1922) | 100 | 1.5500 | 396 |
| 39 | C | Airship (rigid) | 40 | 1.8000 | 432 |
| 40 | B | G.P.O. aeroplane service (Cairo-Baghdad) | 100 | 2.0000 | 480 |
| 41 | B | Private company's aeroplane service (London-Paris letter) | 100 | 2.0500 | 492 |
| 42 | C | Present type four-engined aeroplane | 100 | 2.0900 | 502 |
| 43 | C | Present type single-engine aeroplane | 100 | 2.5700 | 617 |
| 44 | B | A. V. Roe's trips by aeroplane, 1919 | 75 | 2.7500 | 660 |
| 45 | C | R.A.F. in England (min. cost, max. flying hours) | 100 | 3.1000 | 744 |
| 46 | C | Postman | 3 | 4.8500 | 1164 |
| 47 | C | Present type aeroplane in flying school | 60 | 5.0000 | 1200 |
| 48 | B | R.A.F. in India (aeroplane) | 100 | 6.0000 | 1440 |
| 49 | A | R.A.F. aeroplane service (Kenley-Paris, 1919) | 100 | 9.0000 | 2160 |
| 50 | C | R.A.F. in England (max. cost, ordinary flying hours) | 100 | 9.3000 | 2232 |

NOTE.—Those marked A are proved.
Those marked B are according to present charges.
Those marked C are estimated.

## AEROPLANES.

### NOTE.

The running costs of single-engined, two-engined, and four-engined machines of present wood and fabric are derived from the formula $A = \frac{P}{K\,I\,M}$.

A = cost per ton-mile, in pounds, at a given speed.
P = cost in pounds = annual running cost, being first cost of machine plus annual cost of all organisation, fuel, aerodromes, &c., this total annual cost item amounting to the first cost of machine.
K = weight in tons = useful load carried at three-quarter throttle for five hours or percentage of this.
I = miles = miles run per year.
M = minutes per mile = speed at 3000ft. at three-quarter throttle.

The running of the Junker all-metal multiple-engined machine has also been derived from the above formula, P being taken as = cost in pounds = annual running cost, being (first cost of machine × 0.25) + (first cost of machine × 0.50).

* This estimate, £1800 per annum, is for an extravagant user. For the careful user £600 to £700 per year is ample.—ED. THE E.

## Demolition of the Batignolles Tunnels.

THE demolition of the tunnels outside the St. Lazare Station in Paris removes probably the last vestige of the works built by English engineers when they constructed the first railway between Paris and St. Germain. The terminus of the line was originally at the Batignolles, but it was found to be too far away from the centre of the town, and when it was decided to transfer it to the Place du Havre the English engineers in charge undertook the construction of a tunnel under conditions that appeared to the French to present insuperable obstacles. The tunnel, which was constructed in 1837, has a length of 1085ft. When completed it was regarded with great suspicion by Parisians, whose reluctance to travel through it was strengthened by the objections of medical men, who pointed out that passengers would run serious risk of suffocation from the smoke, while those who escaped that disaster were threatened with dangerous colds through the sudden drop of temperature inside the tunnel. It appears from records of the period that the resistance of the atmosphere in the tunnel was regarded by some people as likely to prevent the trains from going through the tunnel at all. The public was so strongly influenced by these objections that the company was obliged to enlist the aid of Royalty, and the first train passing through the tunnel carried a Princess and many of the aristocracy, whose example dispelled the ill omen hanging over the tunnel and successfully opened it up to public service.

As the lines extended a second tunnel was constructed, and then two others, all parallel, and the Batignolles tunnels, while a necessity when houses existed over them, always had a depressing effect upon passengers arriving in Paris. Their demolition was decided upon many years ago, but owing to want of funds for the purpose nothing was done until the catastrophe last year, when a train that had stopped in one tunnel was run into by another, causing a bursting of the gas cylinders and the destruction of one of the trains by fire. The great loss of life led the Government to insist upon the immediate commencement of the demolition of the tunnels.

Of the four tunnels three only are to be demolished. The fourth, through which pass the Auteuil lines, is under the Rue de Rome, and is being stayed by a buttress wall. The demolition is being carried out over 839ft., the remaining 246ft. being under the Boulevard des Batignolles, where it passes beneath the Metropolitan Railway. This part will necessitate considerable preliminary works, due to the displacement of compressed air, gas and other mains and to the replacing of the Metropolitan tunnel by a girder bridge across the railway. It is not expected, however, that the work will be started upon for a considerable time. The demolition of the tunnels was begun in October of last year, and it is anticipated that it will be finished in January next. It necessitates the removal of 117,000 cubic yards of earth and 20,800 cubic yards of masonry, as well as the construction of walls each side, which is now nearly terminated. About 19,500 cubic yards of new masonry have also been constructed.

The problem that had to be faced by the engineers of the State Railways was to effect the demolition without interrupting the traffic. As the number of trains entering and leaving the St. Lazare Station daily is larger than that at any other Paris terminus, the problem presented many difficulties. The only way of solving it was to construct metallic and concrete liners inside the tunnels so that everything could be removed, leaving only the liners to be taken away at the last. In order to provide the necessary working space the double track had to be replaced by a single central track, and on proceeding with the next tunnel the lines had to be relaid in consequence. One line had, therefore, to be temporarily suppressed, and this was done by removing the terminus of the Auteuil line to the Pont Cardinet, just below the Batignolles tunnel. Except for the inconvenience caused to passengers on the Auteuil lines of arriving in Paris at some distance from the centre of the city, there has been no change or interruption to the traffic during the carrying out of the undertaking.

The first part of the work consisted in building the retaining walls on each side of the tunnels, as indicated in the view at the left top corner in Fig. 1. This was a somewhat difficult operation, as the walls had to be constructed in trenches, of which one was from 52ft. to 56ft. deep, while the width was not much more than the thickness at the base. The soil was fairly compact and consistent and did not require much timbering during construction. One of the walls was built on the side of the tunnel which will remain under the Rue de Rome. Meanwhile a metallic lining was erected in the first tunnel to prevent any risk of material falling on the permanent way and to permit of the running of trains during the demolition. The double track was replaced by a single central track to allow of sufficient space for working. The metallic lining consisted of a number of girders, 7in. by 3½in., bent to the form of the arch and spaced 19½in. apart. The tunnel was found to be not quite symmetrical throughout, and recesses had to be chipped away with pneumatic tools. Owing to the small clearance between the coaches and the tunnel, the rings had to be filled in with concrete to provide a smooth surface, and it was at first intended to join up the rings with bolts, to serve as a support for the concrete. The bolts, however, were suppressed when it was found that the concrete would hold without them. As soon as one tunnel was completed the tracks were re-laid to allow of the lining of the next. Immediately on the completion of the side walls the work of removing the earth was started upon, the contract being given out at so much per cubic metre.

A Ruston-Hornsby steam navvy is employed for the purpose, and it appears that it is realising an economy in costs which will more than pay for itself on this one job. A number of Grafton cranes are found to be extremely useful, and, in fact, for excavation and other work preference is frequently given to English cranes on account of their handiness. While the second tunnel was being lined work was started upon the buttress at the side of the tunnel under the Rue de Rome to take the thrust of the wall above. In some places the masonry was so hard that very little impression could be made upon it by pneumatic tools, and where the buttress could not be let into the wall holes had to be drilled in the latter for the insertion of rods to armour the former.

Up to this stage the work is nearly completed and more than one half of the excavation has been carried out, the earth being discharged into motor lorries by the steam shovel. The ends of the tunnel are already exposed, revealing curious differences in their construction. The first arch is built of well-fitting tooled stone blocks and the others of a kind of conglomerate stone found in large quantities around Paris and extracted without quarrying. The solidity of the construction depends as much upon the mortar as upon the stone itself, which is of very irregular shape. Some timbering, completely rotten, was exposed during the excavation. Another curious feature is the space existing over quite a large area between the arches and the soil, despite the considerable compression, and this may be explained apparently by the compact character of the earth. The arches are being demolished with the aid of pneumatic tools.

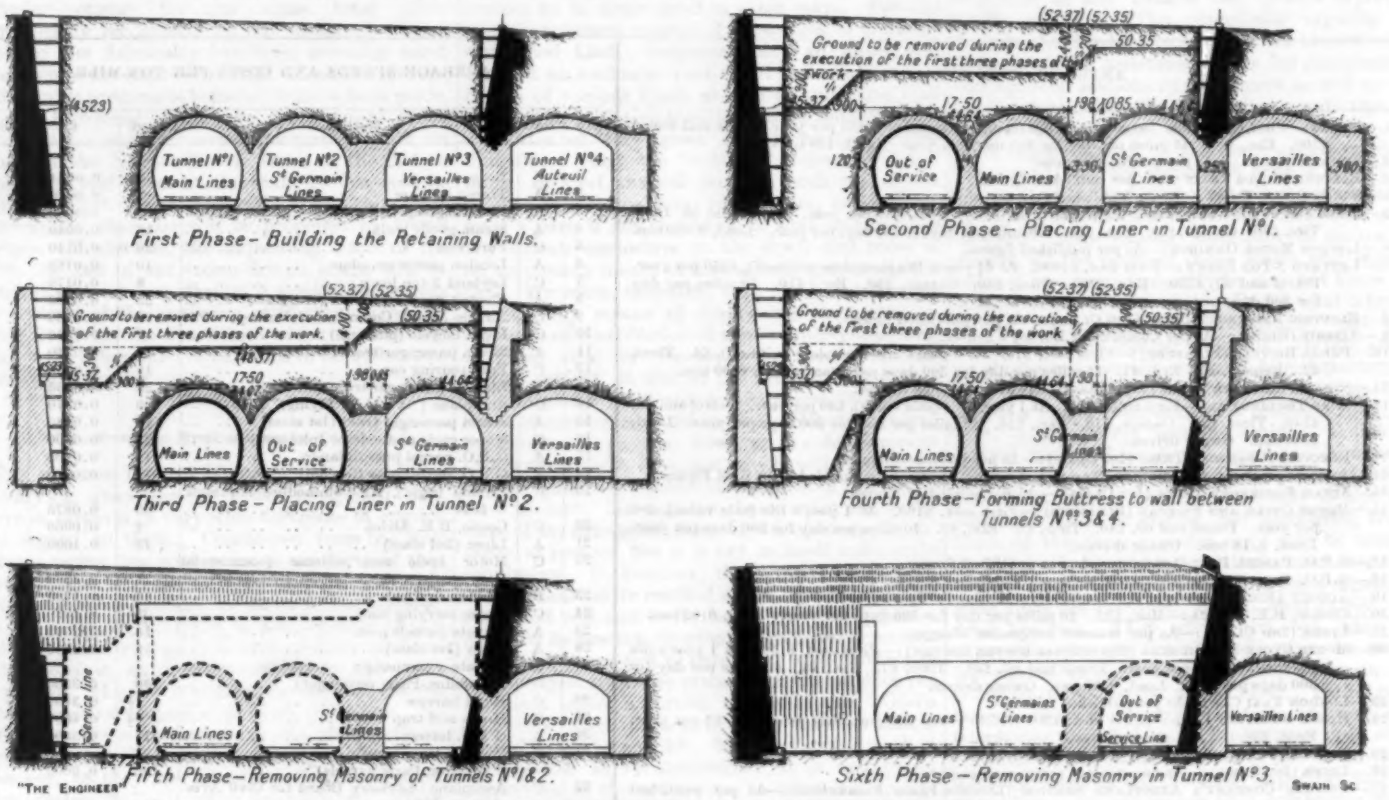

Tunnel N°1 Main Lines
Tunnel N°2 St Germain Lines
Tunnel N°3 Versailles Lines
Tunnel N°4 Auteuil Lines
First Phase – Building the Retaining Walls.
Ground to be removed during the execution of the first three phases of the work.
Out of Service
Main Lines
St Germain Lines
Versailles Lines
Second Phase – Placing Liner in Tunnel N°1.
Third Phase – Placing Liner in Tunnel N°2.
Fourth Phase – Forming Buttress to wall between Tunnels N°s 3 & 4.
Service line
Fifth Phase – Removing Masonry of Tunnels N°1 & 2.
Sixth Phase – Removing Masonry in Tunnel N°3.
"THE ENGINEER"
SWAIN Sc

FIG. 1—PHASES IN THE DEMOLITION OF THE BATIGNOLLES TUNNELS

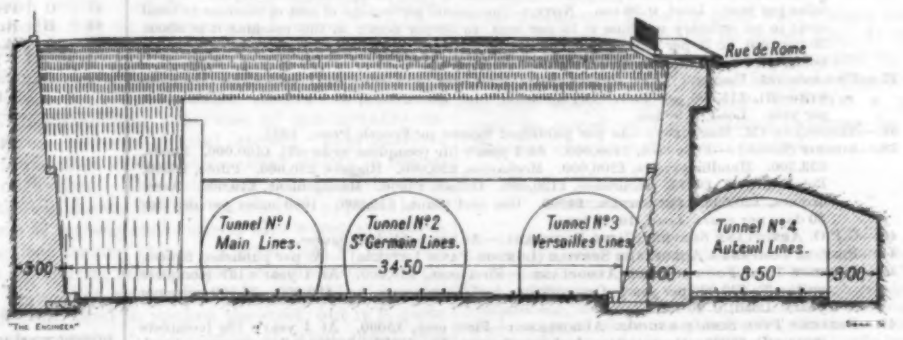


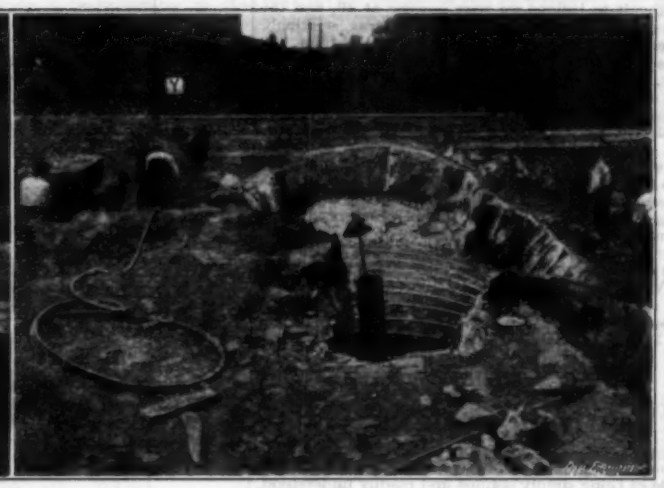

FIG. 2—SECTION THROUGH CUTTING WHEN COMPLETED

# DEMOLITION OF THE BATIGNOLLES TUNNELS, PARIS

VIEW SHOWING RETAINING WALL

EXCAVATION IN PROGRESS

TUNNEL, SHOWING LINER IN POSITION



REMOVAL OF AN ARCH

The work has been carried out so far without the slightest hitch, and reflects great credit upon the engineering staff of the State Railways under the direction of the chief engineer, Monsieur Lévy, who is responsible for the demolition. The successive phases of the work are shown in the drawings, and the half-tone engravings are self-explanatory.

## Train Speeds: A Revelation.

[For many years Mr. Rous-Marten was a regular contributor to The Engineer. His experience in the timing of trains was literally unique, and it is safe to say that no one before and, so far, no one since has reached the high level in recording "runs" which he attained. The publication of a hitherto suppressed letter of his, directed to Mr. Inglis in 1905, is therefore a matter of the greatest interest. We have little or no doubt that it was Mr. Rous-Marten's hope that Mr. Inglis would permit him to publish the extraordinary record in our columns, and we are therefore greatly pleased that we are permitted by the courtesy of the *Great Western Railway Magazine* to reprint from its issue of November, 1922, the article which follows.—Ed. The E.]

The question of train speeds has been much to the fore of late, but nothing so interesting on the subject has been disclosed—nor, indeed, has ever been published—as a communication which we are about to reveal for the first time.

Eighteen years ago the wonderful performances of Great Western Railway special mail trains between Plymouth and Paddington attracted considerable notice, and a writer in the *Railway Magazine*, in an article on "How We Brought the Mails from Plymouth to Paddington," remarked that "'world's records broken weekly' might be the Great Western Railway's motto."

At that time particulars were given in the *Great Western Railway Magazine* of the speeds of some of these special mail trains between various points *en route*, but the maximum speed on any journey was never published.

On May 9th, 1904, one of the special trains, conveying mails from the ss. Kronprinz Wilhelm, performed a record run. The average speed, including a stop at Bristol, was 65.49 miles per hour, or excluding that stoppage, 66.39 miles per hour. Among others who travelled by the train was the late Mr. C. Rous-Marten, a well-known writer on locomotive performances, and he took a systematic instrumental record of the speed. Subsequently he sought permission from the then general manager, Mr. (afterwards Sir) James Inglis, to publish the record, but for various reasons the permission was withheld, and consequently the full particulars remained secret.

We are now enabled to disclose them. The complete story is told in the following communication which was made by Mr. Rous-Marten to Mr. James Inglis on June 20th, 1905:—

"Dear Mr. Inglis,—Pursuant to my recent letter and in accordance with the suggestion in your letter of the 7th instant, I now 'take up the correspondence at the point at which it ceased' relative to the question of publishing the maximum speed in your record run of May, 1904.

"First, let me state my own side of the case. The Great Western is wooing public favour and, very properly, seeking to increase traffic to the Far West by means of extra-fast non-stopping trains. Now, I happened last year to hear a good deal of conversation with reference in particular to those Paddington-Plymouth non-stop runs. To my surprise, many people of different ages, sexes, and callings, declared that nothing would induce them to travel by trains which ran at such 'fearful speeds.' Whenever opportunity decently offered, I 'cut in' and pointed out that in reality these trains did not run, or need to run, nearly so fast as many other Great Western trains which had been running unnoticed for a number of years, and that the time was gained, not through extra speeds, but through lighter loads and absence of stops. This was received with a good deal of incredulity, but when I proved my case, first by the actual figures, and secondly by the proof (although, of course, without giving the actual maximum) that with the Ocean Specials I had on more than one occasion recorded speeds enormously higher than the fastest that are run by the trains in question, and that at these times the travelling was the smoothest, easiest, and therefore safest of any, I was able to compel conviction.

"Now this is the basis of my proposal, that the maximum attained by these non-passenger-carrying specials, which was from 30 to 50 per cent. higher than that run by those best regular long-distance expresses, should now be made public *pour encourager les autres*, or at any rate, to make the travelling public see that when going by your best regular trains, they will not run at a rate at all approaching that which has been attained with perfect ease and safety by non-passenger or experimental specials.

"You have doubtless noticed letters in the papers

*The Log of the Train.*

| Distance. m. | ch. | Stations. | Arrive. h. | m. | s. | Depart. h. | m. | s. | Time occupied. m. | s. | Speed per hour. miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | a.m. | | | | |
| | | Plymouth Mill Bay Crossing .. .. | | — | | 9 | 23 | 10 | — | — | — |
| 23 | 79 | Totnes .. .. .. .. .. .. .. | | — | | 9 | 50 | 49 | 27 | 39 | 52.05 |
| 8 | 55 | Newton Abbott .. .. .. .. .. | | — | | 9 | 59 | 52 | 9 | 3 | 57.59 |
| 20 | 15 | Exeter .. .. .. .. .. .. .. | | — | | 10 | 22 | 12 | 22 | 20 | 54.23 |
| 30 | 63 | Taunton .. .. .. .. .. .. .. | | — | | 10 | 50 | 1 | 27 | 49 | 66.41 |
| 11 | 45 | Bridgwater .. .. .. .. .. .. | | — | | 10 | 59 | 24 | 9 | 23 | 73.94 |
| | | Bristol: | | | | | | | | | |
| 32 | 69 | Pylle Hill .. .. .. .. .. .. | 11 | 26 | 29 | 11 | 30 | 12 | 27 | 5 | 72.80 |
| 1 | 35 | East Depôt .. .. .. .. .. .. | | — | | 11 | 33 | 51 | 3 | 39 | 23.63 |
| 10 | 9 | Bath .. .. .. .. .. .. .. | | — | | 11 | 43 | 50 | 9 | 59 | 60.78 |
| | | | | | | | p.m. | | | | |
| 29 | 48 | Swindon .. .. .. .. .. .. .. | | — | | 12 | 9 | 49 | 25 | 59 | 68.35 |
| 24 | 13 | Didcot .. .. .. .. .. .. .. | | — | | 12 | 29 | 20 | 19 | 31 | 74.28 |
| 17 | 9 | Reading .. .. .. .. .. .. .. | | — | | 12 | 42 | 21 | 13 | 1 | 78.88 |
| 36 | 0 | Paddington—platform .. .. .. | 1 | 9 | 38 | | — | | 27 | 17 | 79.17 |
| | | | | | | | | | From Reading | | |
| | | Paddington—dead stop .. .. .. | 1 | 9 | 58 | | — | | 27 | 37 | — |

| | |
|---|---|
| Total time occupied .. .. .. .. .. .. | Paddington platform, 3 h. 46 min. 28 sec.<br>Paddington dead stop, 3 h. 46 min. 48 sec. |
| Speed per hour throughout, including stop .. .. | 65.49 miles |
| Speed per hour throughout, excluding stop .. .. | 66.39 miles |
| Load of eight-wheeled vans from Plymouth .. | Five |
| Load of eight-wheeled vans from Bristol .. .. | Four |
| Engines and drivers .. .. .. .. .. .. .. | Plymouth to Bristol, No. 3440, City of Truro, Driver Clements<br>Bristol to Paddington, No. 3065, Duke of Connaught, Driver Underhill |

referring to 'terrific' or 'dangerous' speed being run by regular expresses, such as '70 to 80 miles an hour.' But the Record Mail Special averaged 70.2 from the Exeter 'slow pass' to the Bristol stop, and 71.5 from the Bristol start to the Paddington stop, notwithstanding the delays of the Bath service-slack and the very bad special slow over the Cricklade bridge under repair, while between Swindon and Paddington, we maintained a steady average of 80 miles an hour for 73 miles on end.

"These facts have, of course, been published already; indeed, could be readily gathered from the published log of the train. The actual maximum rate has not, so far, got into print. Indeed, I am not aware that anybody but myself recorded it with absolute accuracy, although I suspect that one of the Post Office people must have done some timing, for he came very near the truth in that Plymouth paper's article which I sent you, and which gives an illustration of 'City of Truro averaging 99 to 100 miles an hour.' But, of course, a mere statement in a daily newspaper carries but little weight.

"*Confidential.*—In now giving you my actual figures, it is, I feel sure, unnecessary for me to stipulate that they shall be regarded as strictly confidential, and that in no case shall my information be used to anybody's prejudice. Upon that I am quite certain I can depend without any specific pledge on your part.

"What happened was this: when we topped the Whiteball Summit, we were still doing 63 miles an hour; when we emerged from the Whiteball Tunnel we had reached 80; thenceforward our velocity rapidly and steadily increased, the quarter-mile times diminishing from 11 sec. at the tunnel entrance to 10.6 sec., 10.2 sec., 10 sec., 9.8 sec., 9.4 sec., 9.2 sec., and finally to 8.8 sec., this last being equivalent to a rate of 102.3 miles an hour. The two quickest quarters thus occupied exactly 18 sec. for the half-mile, equal to 100 miles an hour. At this time the travelling was so curiously smooth that, but for the sound, it was difficult to believe we were moving at all, and the perfect control retained over the train was strikingly manifested through what appeared at the time the vexatious incident of those platelayers dawdling on the 4ft. way, which compelled a sudden reduction of the speed by about one-half, which was effected in the readiest and simplest way conceivable, without the slightest jerk or irregularity.

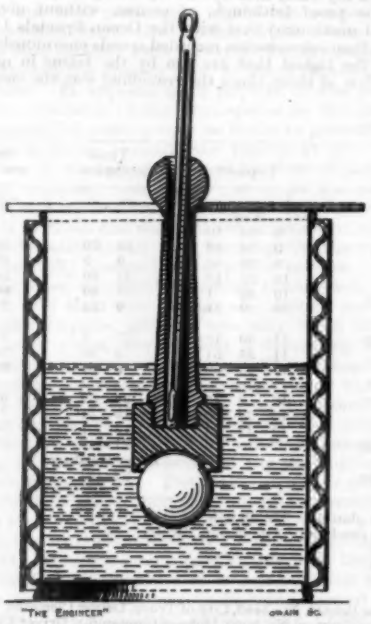
"And now 'the murder is out'! It seems to me to afford a strong argument for the consolation of the timid folk who might otherwise be deterred from enjoying the comfort and celerity of your splendid expresses, to be able to impress upon them that at the highest speed they would travel they would be going quite slowly compared with that at which the mail special ran with entire ease and safety. I hope you will agree with me in this opinion. —I am, Yours very sincerely,

"C. ROUS-MARTEN.

"Eldon Chambers,
"30, Fleet-street, E.C."

## A New Form of Viscometer.

ALTHOUGH the property of a fluid known as its viscosity is capable of being simply defined and readily understood, it is by no means a quantity that may easily be determined with accuracy, so far at least as the better known existing forms of viscometer are concerned. Generally speaking, accurate viscometry is a matter claiming the attention of experienced laboratory workers. This fact is regrettable, for viscosity in fluids notably, of course, in lubricating and fuel oils is a factor of high practical importance and should, therefore, be determinable quickly and accurately by means of simple appliances requiring little operative skill or delicacy of handling.




VISCOMETER IN INSULATED POT

In this country the Redwood viscometer is probably the most widely used form of apparatus for the purpose in question. In the United States the Saybolt, and on the Continent the Engler viscometers occupy that position. These and most other existing forms of viscometer make use of the efflux principle, that is to say, they determine the viscosity coefficient by measuring the rate of flow of the fluid from a capillary tube. The basis of this method is to be found in the experiments conducted by Poiseuille in 1843, which established the result that the volume V of fluid flowing out of a capillary tube of radius $r$ and length $l$ in an interval of time, $t$ is given by the expression

$$V = \pi p r^4 t / 8 l \eta,$$

$p$ being the pressure difference between the two ends of the tube and $\eta$ the coefficient of viscosity of the fluid. Those interested in the efflux method will find it discussed at some length in our issue of June 13th, 1913, in an article describing Rhodin's viscometer, a device working on this principle. It is sufficient here to say that the efflux method requires considerable time and skill for the obtaining of accurate results, calls for great accuracy in the calibration of the capillary tube—notably so with respect to its bore—and necessitates the application of various complicated "corrections" to the observed results. Moreover, the coefficient has to be calculated from the observed values of the volume and time by means of the Poiseuille or similar formula, or, in order to simplify the work, is expressed in various arbitrary units, such as Redwood "seconds" or Engler "numbers."

The Michell viscometer now being supplied by Michell Bearings, Limited, 3, Central-buildings, S.W.1, is, we believe, an entirely new form of instrument, and possesses features which are not found in any other similar apparatus with which we are acquainted. Its outstanding characteristic is its simplicity, both of design and of operation. It consists of two main elements, a hardened steel ball 1in. in diameter, and weighing 67 grains, and a hardened steel hemispherical cup at the end of a hollow handle forming a thermometer pocket, and provided at the other end with a round gripping piece formed of vulcanite. The sphericity, both of the ball and the cup, is correct to one-ten-thousandth part of an inch. The cup is formed on a lens-grinding machine, and while the metal is in the soft state, is impressed by a hardened ball in which three small blind holes have been drilled. This ball when in the cup is struck with a hammer, with the result that three small pips are raised on the concave surface of the cup. These pips have a diameter of about $^1/_{16}$in., and when finished by grinding have a height of one to two-thousandths of an inch, their exact height being varied to suit the "constant" which it is desired the instrument should have. The mouth of the cup is counter-bored about $^1/_{64}$in. deep and about $^1/_{64}$in. wider all round than the undisturbed diameter. After finishing to form, the cup is hardened without distortion. It may here be stated that the actual manufacture of the viscometer is carried out by Adam Hilger, Limited, of London.

THE MICHELL CUP AND BALL VISCOMETER

In use three drops or so of the oil to be tested are placed in the cup, which is then inverted and pressed down on top of the steel ball, with the object of bringing the faces of the pips and the surface of the ball into metallic contact. When this condition is reached, there is a film of oil of definite thickness between the cup and the ball, except for the areas represented by the pips, and, in addition, a reservoir of oil held in the counterbore round the mouth of the cup by surface tension. The cup and ball are now raised, and the time from the raising to the instant at which the ball drops out of the cup is accurately observed. This time divided by the "constant" of the instrument, gives the viscosity in absolute units, namely, in dynes per square centimetre. The instrument during the whole trial is handled entirely from the vulcanite knob, for the viscosity of an oil is sufficiently sensitive to be affected by the heat which would be transmitted from the hand.

The theory of the instrument is no doubt a matter of some complexity. The action, however, is quite simple. When the ball and cup are raised the ball immediately begins to fall out of the cup, with the result that oil from the counterbore reservoir flows into the space between the ball and cup, and thickens the film of oil existing there. The rate of inflow is a measure of the viscosity of the oil, and, strictly speaking, should be constant from the beginning right up to the instant at which the ball falls. Investigation shows that the velocity of influx must be very nearly constant over a large part of the falling period, and that the ball falls at almost a uniform rate for at least 75 per cent. of the time during which it is under viscous restraint. Careful calibration of each instrument with oils, the viscosities of which are accurately known, reveals the fact that the average error in the results obtained with the Michell viscometer is about 4 per cent. A considerable effect on the figure arrived at can be exerted by varying the pressure and the length of time of its application to the handle at the outset of the determination It is found, however, that if the force used is that of the full weight of the hand, say, 5 lb. to 6 lb., and if the time of application is about half that shown by a rough trial to be required for the separation of the ball and cup, the influence of the initial pressure is reduced to a negligible value.

As an indication of the time taken by the ball to drop, we may consider an oil with an absolute viscosity of 1 dyne per square centimetre, approximately the value shown by olive and rape oils at 60 deg. Fah. An instrument having a constant of four would show a time of about 4 sec. Such a period would be too short for accurate timing, and would probably be lengthened to about 20 sec. or 30 sec. by employing an instrument with a constant of 20 or 30 respectively. For a low viscosity oil a high constant instrument is used, and *vice versâ*.

For laboratory use, especially when it is desired to investigate the variation of viscosity with temperature, the determination is carried out not in the air but in a bath of the oil heated to the required temperature. The ball is placed at the foot of the bath and the cup pressed down on it in the manner described above. When the cup and ball are raised, care is taken to see that they are not lifted above the surface of the oil in the bath. If the bath is heated up to the maximum temperature, successive readings may be taken while the temperature is falling, in order to determine the variation of the viscosity with temperature over an extended range. The line engraving illustrates the instrument being used in this manner in an insulated container. Strictly speaking, the "constant" of an instrument is applicable only to the laboratory method. For working in air the "constant" should be multiplied by 0.9.

It is obvious, we think, that as compared with the usual form of viscometer based on the efflux method, the Michell viscometer is very well adapted for the practical determination of viscosity by engineers and others who are not highly trained observers of physical properties. For lubricating oil tests it should have many applications, but almost as important a use for it will probably be found in connection with fuel oils. By its aid, for instance, the sea-going engineer in a foreign port will be able to compare accurately and quickly the viscosity of a new supply of fuel with that which was previously being used, and thus obtain a control over the new supply and the manner of its consumption much more complete than is possible by a determination simply of its specific gravity.

Certain obvious precautions must be taken with the instrument. It must not, for instance, be allowed to become magnetised, although if it does become magnetic it can be demagnetised by placing it in an alternating field in the usual way. Care must also be taken to prevent any particles of grit or other foreign matter from settling between the ball and the pips in the cup. In this connection it may be noted that such grit so situated would result in the indication of a low viscosity, whereas with a viscometer using the efflux method the presence of grit makes the flow more sluggish and, therefore, indicates a viscosity which is too high. On changing from one oil to another, the cup and ball must, of course, be cleaned—say, with petrol—but in this matter the trouble involved is small and distinctly less than in the case of an efflux viscometer. On the score of first cost, the Michell apparatus shows some economy as compared with some other viscometers of the usual type, but it is not quite correct to say that it is a cheap instrument, for, as all engineers will appreciate, the careful grinding and hardening of the cup, the great accuracy required in the ball, and the individual calibration of each instrument, are factors weighing against cheap production.

A special form of the instrument has been designed to enable very low viscosities to be determined in the laboratory. In this form the weight of the ball is counterbalanced, and the force separating it from the cup—a constant quantity in the standard instrument—is applied by means of weights placed in the pan of a balance, from the arm of which the ball is suspended above the cup. An attachment for use in conjunction with this arrangement enables the viscosity of gases to be determined,

## Extensions at the Hastings Electricity Works.

On Wednesday of last week some new plant was officially set to work at the Hastings electricity supply station. The Hastings electricity undertaking is one of the oldest in the United Kingdom, the station at Earl-street having now been in operation for a period of forty years. Originally the plant consisted of Brush series 2000-volt lighting dynamos, which were driven by undertype locomotive engines. Besides supplying all the street arc and incandescent lamps, these dynamos also generated the current for the lamps on consumers' premises at a pressure of 2000 volts. In 1890 the electric lighting company obtained a Provisional Order, and the plant was then re-designed to conform with more modern ideas, the series lighting dynamos being replaced by rope-driven Brush alternators, and the distribution system being arranged for the supply of current through transformers placed on the consumer's premises. In 1893 additional land was purchased, and in 1899 structural alterations were made to the engine-room and boiler-house. These alterations included raising the engine-room roof to permit the use of an overhead travelling crane, and the arrangement of the buildings was also modified to provide for offices, a test-room and a coal store.

On January 1st, 1899, the electric lighting company was purchased by the Hastings Corporation, and it is said that during the first year of working under municipal control the price of energy was reduced by something like 25 per cent., with the result that the demand for current considerably increased. At this period the plant consisted of three 100-kilowatt and two 200-kilowatt Brush sets, and one 500-kilowatt Parsons turbo-generator, and this plant is still in operation. The Parsons turbo-alternator was found to result in an appreciable reduction in the running costs, its steam consumption at full load being 22 lb. per kilowatt-hour. The boiler-house plant consisted of three land type and two marine type Babcock and Wilcox boilers, the latter being equipped with Green's economisers.

The rapid growth of the undertaking in recent years necessitated the Committee applying to the Electricity Commissioners for power to extend the plant still further, and sanction having been obtained, tenders were called for. The new plant, which was officially set to work last week, consists of a 1125-kilowatt Brush-Ljungström turbo-alternator set with condenser, two Stirling boilers with Underfeed self-contained stokers, a Premier cooling tower, and new pipe work. New structural building work also had to be undertaken. The Ljungström turbine, which has been supplied by the Brush Company, is designed to work with a steam pressure of 170 lb. per square inch, with a total temperature at the stop valve of 475 deg. Fah., and to exhaust into a vacuum of 28in., with the barometer at 30in. The set is capable of giving an overload of 25 per cent. for two hours, and it runs at a speed of 3000 revolutions per minute. In accordance with the usual Ljungström design, the rotor of the turbine is coupled to two alternators, which work in parallel.

Each alternator generates single-phase current at a pressure of 2000 volts and a periodicity of 50 cycles, the combined output being 1125 kilowatts at .9 power factor. The Brush surface condenser has a cooling surface of 2500 square feet and a capacity of 13,350 lb. of steam per hour, and is capable of maintaining a vacuum of 28in. when supplied with 2300 gallons of circulating water per minute at a temperature of 80 deg. Fah.

The condenser contains 1070 tubes, which are ⅝in. in diameter and 12ft. long. The auxiliaries consist of a three-throw Brush-Edwards air pump and a lift pump driven off the air pump crank shaft for pumping the condensate to the hot well. The air pump is driven by a Bumsted and Chandler 9 horse-power single-crank non-compound double-acting forced-lubricated engine, which runs at a speed of 600 revolutions per minute. This engine works under the same steam conditions as the turbine, and is capable of developing the power required when exhausting against a back pressure of 10 lb. per square inch above the atmospheric pressure. The alternators are fitted with a duplex-type exciter shunt regulator, which is mounted on the front of the switchboard.

For filtering the cooling air supplied to the alternators, a Cleworth-Wheal wet air filter is provided, and it is driven through gearing by a 1 horse-power direct-current motor, the air filter being connected to the alternators by means of sheet steel ducts. The new boiler plant, which was supplied by the Stirling Boiler Company, Limited, consists of two Stirling boilers with integral superheaters, and fitted with Underfeed self-contained stokers. Each boiler has 255 main tubes with an outside diameter of 3½in., the heating surface being 2644 square feet. The total heating surface of the boilers, namely, 5288 square feet, is considered to be great for the space occupied, which is 19ft. high, 20ft. 3in. wide, and 20ft. deep. Each boiler is fitted with a U type superheater, having an effective heating surface of 175ft., and the superheaters are fitted immediately behind the front bank of water tubes. The headers are at the top and the caps out of contact with the products of combustion. The working pressure of the boiler plant is 180 lb. per square inch, and the steam is superheated to the extent of 100 deg. Fah. The normal evaporation of each boiler is 10,000 lb. of water per hour, but this may readily be exceeded. The Underfeed stokers, supplied by the Underfeed Stoker Company, work with a combined system of forced and natural draught, the grate surface of each stoker being 57 square feet and the normal coal consumption per grate 12 cwt. per hour. From hoppers above and in front of the boilers, the coal is fed into the stoker hoppers by chutes, and it is regulated by duplex coal valves. Lea coal meters are fitted to and driven by the mechanical stokers. The natural draught is provided by a brick chimney, into which the Babcock and Wilcox boilers discharge, the connecting flue being underground. Besides the usual Durance fittings, the boilers are fitted with Crosby automatic feed-water regulators.

The whole of the constructional steel work and fire-resisting flooring work was carried out by the Fawcett Constructional Company, Limited; whilst Hayhurst and Wright, of Hastings, acting as sub-contractors to the Fawcett Constructional Company, carried out the general building work. The contract for the pipe work for the turbo-alternator, condensing plant and cooling tower was awarded to Aiton and Co., Limited, of Derby. The Premier cooling tower, which was supplied by the Premier Cooler and Engineering Company, Limited, is of the forced draught type, and was specially designed to suit the restricted space available. It is capable of reducing the temperature of 130,000 gallons of water per hour from 99 deg. Fah. down to 80 deg. Fah., when the air temperature is 55 deg. Fah. and the humidity 75 per cent. Although the plant has been designed primarily as a forced draught plant, provision has been made for operating it on natural draught at times of light load, the air in this case being passed through special doors at the base of the tower. When the cooler is working under the forced draught conditions, the air is supplied by two steel plate fans, which are 9ft. in diameter. These fans are mounted on a common shaft and are driven by a high-speed engine built by Bumsted and Chandler. The fans are of the impeller type and normally absorb not more than 24 horse-power.

The plans for the new extensions were prepared by the borough electrical engineer, Mr. Russell F. Ferguson, who is to be congratulated upon the general design. It is well known that the Ljungström turbine is admirably suited for stations such as that at Hastings, and that quite a number of these machines have of late been put into operation. The steam consumption of the Hastings set is said to be less than 13¾ lb. per kilowatt-hour, which is quite good for a set of this output and working under the station conditions specified.

## SWISS INDUSTRY AND COMMERCE FOR 1921.

The Administrative Committee of the Swiss Commercial and Industrial Union, Zurich, a body similar to the Association of British Chambers of Commerce, issues every year a general report on the above. That for the past year (of about 450 pages) has just been issued; as in the past, it contains a full account of the economic life of Switzerland during 1921, and furnishes full material in all directions for those who, more particularly abroad, are desirous of making themselves acquainted with the commercial and industrial activity of the country. The report for 1921 is of special interest, inasmuch as it clearly shows the effect on Switzerland of the general economic crisis during the period covered by it.

Following the same plan as the preceding volumes, it opens with statistical tables which furnish numerous particulars relating to Swiss economic conditions—population, professions, resources, cost of living, foreign trade, customs, banks, insurance, public companies and finance, &c. &c.

Its second portion, very much more detailed, reviews in forty chapters the various branches of commerce and industry. At the head of each chapter will be found an extract from the official Swiss Journal of Commerce, giving the export and import figures of the particular trade or industry in question. These tables afford detailed information on the relations of Switzerland with other countries, and being repeated year by year enable comparisons to be made with successive years. Numerous comparative figures on production, wages, prices, &c., are also given, and special attention is devoted to banking and insurance concerns, and general finance. Special chapters deal with commercial and professional training in Switzerland, as well as with markets, fairs, &c. &c.

The report (in French or German) can be purchased from the Secretary of the Union.

## THE DEVELOPMENT OF GERMAN INDUSTRY SINCE THE WAR.

The Paris *Journal*, in the course of a long article which it published a day or two ago, drew attention to the progress made by German industry since the war, and its present flourishing condition, as compared with industry in many of the Allied countries. It was pointed out that though Germany had lost considerable territory, and that though her population had fallen from 67 millions to 62 millions, nevertheless in 1921 as many industrial enterprises were being exploited and as many workers were employed as in 1913. Figures were given for 1913, 1919, and 1921, showing the number of establishments subject to Government inspection, *i.e.*, employing more than ten workers, together with the number of workers employed. In 1913, there were 323,524 establishments employing 7,386,173 workers; in 1919, 286,946 establishments with 6,301,152 workers; in 1921, 324,169 establishments with 7,461,407 workers. For 1919 and 1921, the whole of Upper Silesia was included in these figures; on the other hand, the Sarre basin was not.

Thus in two years Germany recovered all the ground she had lost industrially during the war. This recovery was not so marked in all branches of industry. For example, in the textile trade there were only 12,435 establishments, employing 750,561 workers, as compared with 17,400 with 905,076 workers in 1913. On the other hand, even though with Lorraine Germany had lost her most important iron basin, the metallurgic industry had made great strides, and is now in a more prosperous condition than before the war. In 1913 there were 25,334 establishments manufacturing small metal goods, and employing 680,107 workers. In 1921 that number had increased to 30,771 with 717,342 workers. These figures were also higher than those of 1919. The increase was still greater in the machinery industry; in 1913 there were 23,291 establishments employing 1,173,481 workers; and in 1921, 30,525 establishments employing 1,462,282 workers. There has, however, been no increase in the number of blast-furnaces and steel works; the German metal industry is buying ore, cast iron, &c., abroad.

This activity, the *Journal* points out, has nevertheless been bought at a price. German industry, anxious to recover its foreign markets, has sacrificed everything to this end. Profiting by the low rate of the mark, German manufacturers are selling their goods at prices far below the usual rates prevailing in the world markets. This procedure has deprived Germany of the means of increasing the value of the mark, and manufacturers, although they may be making satisfactory profits in paper marks, are nevertheless selling at prices inferior to the real value of their goods. Thus German industry has triumphed over its competitors, at the price of bringing Germany near financial ruin.

## THE ELECTRICITY COMMISSION.

The Electricity Commissioners have had under consideration the procedure at local inquiries, to be held by them for the purpose of determining the areas of electricity districts and of approving schemes for the re-organisation of the supply, including the setting up of joint electricity authorities. It is not intended at present, at any rate, to lay down new rules of procedure. The conduct of the proceedings at these inquiries will conform generally with that of the past, but it is considered desirable, in the interests of all concerned, that unnecessary expense should be avoided, and that the inquiries should not be unnecessarily prolonged.

In the first place it is hoped that there will be a large measure of agreement in regard to the delimitation of the various areas, and the schemes for their administration. The Commissioners have endeavoured to promote such agreement, and they trust that in the interval between the lodgment of a scheme and the time when it is considered at a local inquiry, it may be found practicable for promoters and objectors to confer, with a view to adjusting differences, or of reducing them to a minimum, so as to shorten the proceedings at the inquiry. Realising the importance of the interests involved, the Commissioners have no desire to interfere with the discretion of the parties regarding the employment of counsel and the calling of expert and other witnesses, but they suggest that the parties should not be separately represented by counsel or otherwise, unless their interests are divergent, and then only to the extent of such divergence.

As regards witnesses, the Commissioners are of opinion that it should not ordinarily be necessary for more than one witness, representative of each class or group, of promoting or opposing local authorities or companies to be called as to policy. On the technical side of the scheme, promoters and opponents should bear in mind the composition of the tribunal, and that while expert evidence should be adequate to support or criticise the scheme in its different aspects, the mere duplication of such evidence with the object of adding weight is unnecessary. The Commissioners propose that where possible there should only be one local inquiry into both the area and the scheme for the district, and that this should be the principal inquiry. When a scheme has been approved by the Commissioners as the result of such inquiry, the proceedings of the further local inquiry should ordinarily be more or less formal or confined to specific points of controversy.

## THE EAST OF SCOTLAND ELECTRICITY DISTRICT.

In pursuance of a notice issued by the Electricity Commissioners on February 24th concerning the provisional determination by them of the East of Scotland Electricity District, the Commissioners now give notice that they will hold a local inquiry in the City Chambers, Edinburgh, on December 12th, at 10.30 a.m., and days following. The meetings will have reference to the area to be included in the proposed district, and the objections and representations which have been made on account of the inclusion or exclusion from the district of certain areas. It is intended to consider a scheme which has been submitted by the Corporation of Edinburgh for effecting an improvement of the existing organisation for the supply of electricity in the district, and for the formation of a joint electricity authority. Copies of the scheme may be obtained from the Town Clerk, City Chambers, Edinburgh, at a cost of 1s. 6d., whilst copies of supplementary particulars in support of the scheme may be purchased at a cost of 10s. each, on application at the address stated prior to the date of the inquiry. Any body or person interested may attend the inquiry either personally, or may be represented by counsel, solicitor, or agent. Any communications with regard to the scheme should be addressed to the Secretary, Electricity Commission, Gwydra House, Whitehall, London, S.W.1, not later than December 5th, and a copy of such communication should be sent at the same time to the Town Clerk, Edinburgh.

The Irish Power Syndicate has applied for a special order under the Electricity Supply Acts for authority to utilise the river Liffey for generating electricity. It is proposed to erect stations at Bishopland and Downings North (Co. Kildare).

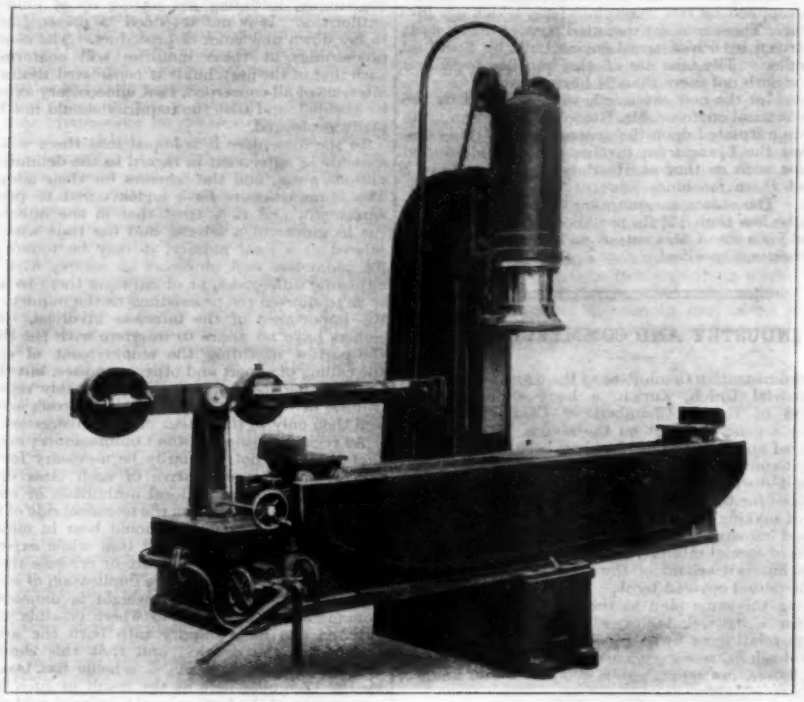
According to a report from *The Times* Paris correspondent, M. Edouard Belin has devised a method for secret wireless communication. As in his apparatus for the transmission of script and pictures by wireless or by telephone, he employs a device for securing the almost absolute synchronism of motors at the receiving and transmitting stations. These actuate a cylinder through the medium of six concentric discs provided with notches and levers which, when engaged, revolve the cylinder. They can be set to an almost indefinite number of combinations. The particular combination at which a message is to be passed is selected beforehand by the receiving and transmitting stations, and so long as it is known only to them, secrecy is secured. It is possible, however, that, by long and patient watching, a stranger might note the periods of silence and so contrive to read the messages. M. Belin has added an adaptation from a well-known mechanical cipher in which the significant words occur in the course of an apparently continuous page of writing or printing, but can be detected by placing over the sheet a secret stencil cut so as to reveal only the message. The intervals of silence in M. Belin's device are filled by messages sent out from a subsidiary apparatus and with no other purpose than to conceal the existence of the gaps.

## Hydraulic Spring-Testing Machine.

THE hydraulic spring-testing machine, illustrated herewith, has been recently erected at the Sheffield Works of Vickers Limited. The machine is for the purpose of testing heavy coil and laminated springs as used for railway rolling stock, and its use ensures the standardising of these details as regards deflection under load.

As will be seen from the the engraving, the hydraulic cylinder and ram are carried overhead by a cast iron column, the cylinder being connected up to the existing hydraulic supply. The table upon which the spring is seated is the upper platform of a weighing system, the levers of which are compounded and are fitted with the usual knife edges and bearings. The lever system is connected up to the steelyard which is placed at the rear of the platform. In this position the steelyard is not only safeguarded from injury but is not in the way when placing laminated springs in position for conducting a test. The poise of the steelyard is propelled by a screw under the control of a hand wheel at the front of the machine, and situated close to the valve, by which the hydraulic supply is regulated.

Laminated springs up to 9ft. in length and coil springs up to 29in. in height and 10in. diameter, can be accommodated in the machine. The full load capacity is 25 tons. The deflection of the spring under load is indicated by a pointer travelling with the ram and indicating against a graduated deflection scale upon the column. The high capacity of the machine would seem to indicate that rolling stock springs are gradually increasing in size. It has been designed and specially constructed by W. and T. Avery, Limited, of Birmingham, to suit Messrs. Vickers' requirements.



HYDRAULIC TESTING MACHINE FOR RAILWAY SPRINGS

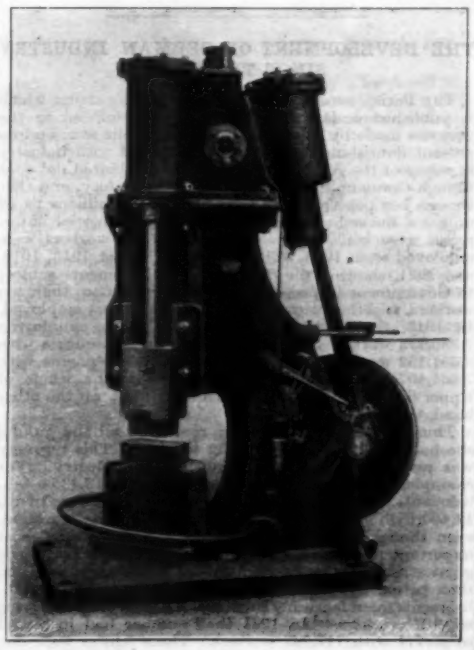
## Single-Blow Pneumatic Power Hammer.

A NEW and interesting feature has recently been introduced by B. and S. Massey Limited, Openshaw, Manchester, into the design of their pneumatic power hammers—a feature which makes it possible to strike powerful single blows from either the top of the piston stroke or from any intermediate position. The makers claim that by means of this improvement the chief limitation which has hitherto restricted the utility of pneumatic power hammers is removed. It has, of course, always been possible, with the Massey pneumatic hammers, to obtain fairly satisfactory single blows by first lowering the tup on to the job, but some care had to be exercised in the operation as it was necessary to lower the hand-lever first as the pump piston was beginning its upward movement. The original patent specification included a timing device which indicated to the operator the precise moment for depressing the hand-lever in order to obtain the most powerful single blow—an arrangement which was fitted to some of the earlier hammers but was eventually abandoned in all but the largest sizes of hammers.

In the new type of hammer, which is illustrated herewith, the mechanism which makes it possible to strike single blows is not in any way separate, but forms part of the general design. Briefly, the new feature comprises an arrangement by which a reservoir is formed in the cylinder casting. The reservoir is charged with air by the pump and the maximum air pressure in it is determined by a system of clearance governing, thus obviating any complication such as results from the use of controllers. The provision of this reservoir makes it possible to strike single blows whenever required, and without reference to the speed or position of the pump piston. These blows can be struck from the top of the stroke, or from any intermediate position, and can be obtained either by the movement of the foot lever or the hand lever, which are arranged to work independently of each other. In addition to these single blows, for each of which a separate movement of the hand or foot lever is necessary, the hammer provides the full range of self-acting blows, including light blows with long strokes, which make it possible to strike on the top of quite high work. The tup can also be held up or held down, and in all particulars the control is sensitive and responsive.

With the hand lever in the position shown in the engraving, which is the "not working" position, the air passes freely between the top and bottom of the pump cylinder without being compressed by the movements of the pump piston. When the hand lever is raised to the "hold up" position, the tup rises quickly to the top of its stroke and remains suspended there, the pump, at the same time, filling the reservoir and keeping the air pressure at its maximum. When the hand lever is put into the "hold down" position, the full reservoir pressure is exerted above the hammer piston, and the space below the piston is opened to the atmosphere. Work can therefore be securely gripped between the palletts for bending purposes, &c. By moving the lever from the "hold up" to the "hold down" position and back again, single hand-worked blows are obtained, the force and the length of which can be varied at will. As the hand lever is moved downwards from the "not working" position, the hammer begins to strike a series of light blows with short strokes. The stroke gradually lengthens as the downward motion of the hand lever is continued, and the blow changes in character until the "elastic" or "swing" blow is obtained—a light cushioned blow with a long stroke which is very useful for finishing and edging thin work. Further lowering of the hand lever causes the weight of the blow and the length of the stroke to increase, until finally, as the hand lever reaches its lowest position, self-acting blows of the maximum stroke and weight are obtained.

It will thus be seen that in addition to a wide range of self-acting blows, these hammers can strike reliable single dead blows which are very useful for all punching, stamping and similar operations. At present this new feature is embodied in the 2, 3, 5, and 20 cwt. hammers, We have had an opportunity of inspecting one of the 5 cwt. size under working conditions and can support the claims which the makers put forward.

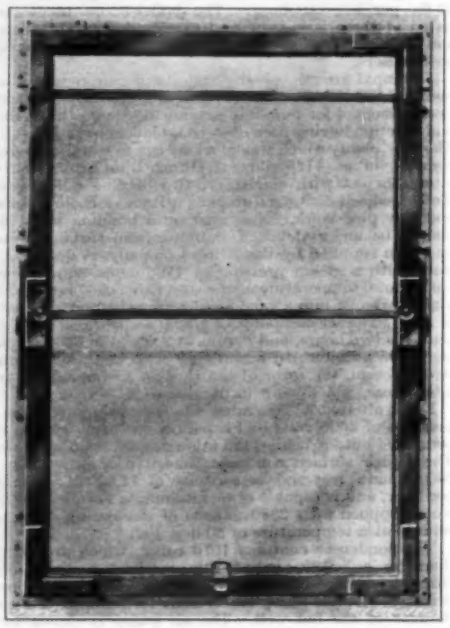


HAMMER WITH SINGLE BLOW GEAR

## A New Ship's Window.

DURING a recent visit to the Deptford works of J. Stone and Co., Limited, we noticed a new type of ship's window that appealed to us on account of the extremely simple manner in which it overcomes one of the principal objections to self balancing sashes.

The window, which we illustrate herewith, is intended for the upper parts of large vessels, where it is not liable to be subject to anything worse than ordinary weather, and where, consequently, it is desirable to follow the lines of the orthodox house window as nearly as possible. It comprises two equal sashes, and instead of employing weights to balance each one individually, they are balanced one against the other. The balancing connection is simply affected by providing a pair of small pinions, one on each side of the window, which mesh with, and between, racks cut on the top and bottom sashes. Thus when the bottom half is pushed up the top half is lowered and *vice versâ*. It is, however, sometimes desirable to open the top of a window without moving the lower half, which would be impossible if the balancing arrangement were left just as described. The pinions are thus mounted in little frames, which can be slid vertically through a short distance, and which are controlled by the two hand levers seen at the extreme of the window on either side. If the pinion frames are lowered a short distance the upper sash will, of course, be dropped to twice that extent, but the balance will still be maintained. At the bottom of the window there is, it will be noticed, a catch, which locks by gravity. This catch engages immediately the bottom sash is closed and holds it securely, with the result that neither the bottom or top half can be opened from the outside until the catch is released. Thumb-screws are provided at the centre of the frame for tightening down to prevent rattling.



NEW FORM OF SHIP'S WINDOW

The whole window is built up of extruded brass sections mitred at the joints and strengthened with screwed-on angles. It is thus a simple matter to make windows of any size. The glass is held in channel-shaped frames by putty, and is slipped in place vertically, after which a light cover plate is screwed over the entrance slot.

MERCURY occurs native—that is to say, in a more or less pure state—and in greater extent as mercuric sulphide, or cinnabar, a red crystalline substance. The chief sources of supply are the mines in Spain, Italy, Austria, California, Siberia, and China. Of these, the Almaden mines of Spain and those of Idria, in the Monte Amida district of Italy, appear to be the chief sources; in fact, it is stated in the *Raw Materials Review* that either could supply the present needs of the whole world and its probable requirements for a long time to come. In the United States, where large deposits occur, the output showed a steady decline for a long period before the outbreak of hostilities. This state of things was signally changed by the war, when the old-established fields of California resumed an intense activity, which appears to have suddenly ceased since the year 1918. Prior to 1914 England absorbed the bulk of the Spanish quicksilver and Germany found use for all that Austria could export, while the two markets consumed the great part of the Italian output.

## Institution of Electrical Engineers.

THE informal section of the Institution of Electrical Engineers commenced the new session on the evening of Monday, 6th, with a discourse by the President, Mr. F. Gill, on the "Importance of Commercial Knowledge to the Engineer." Mr. W. E. Warrilow was in the chair, and a large gathering was treated to an excellent and stimulating address, which evoked an interesting and well-maintained discussion. The fundamental and true function of the engineer, said Mr. Gill, was to apply physical laws with the least expenditure of capital. It was becoming more and more important for the engineer to study the phraseology and methods of business. The engineer to-day should know the elements of accountancy, the rudiments of a balance-sheet, &c., and Mr. Gill went on to enumerate some of the commercial issues that vitally concern the engineer. The London supply authorities were supposed to be unable to extend their business because of the imminent termination of their licences. That termination was about nine years hence, and if that period was considered too great a hindrance it was very evident how badly needed was the study of economy by engineers.

When asking Mr. Pooley to open the discussion, Mr. Gill paid a warm tribute to the work Mr. Pooley had done, particularly for the informal section of the Institution, as its Chairman during the past two years.

In the course of his remarks, Mr. Pooley said that it was the duty of all to utilise their brains in a matter which would result in benefit to the community, and not necessarily in the most interesting matter. It was necessary to have a commercial knowledge, for without it the engineer or pure scientist could not reap the benefit of his industry.

Mr. F. E. Masters thought the desire to direct the scientist's brain into commercial channels would be wrong—even if it were possible. The theoretical man likes to roam over his interests without troubling about commercial values, but as they all know great commercial values often resulted.

Dr. L. W. Phillips thought that there was some need for commercial training in the colleges, and went on to explain how the student found discipline in a works a very different thing from that which he had previously been accustomed to.

Mr. W. Lawes suggested that the principals of works might formulate reports to the principals of colleges reagrding the shortcomings in the training of students.

Mr. Arthur Wright thought it appeared from the discussion that there was some danger of misunderstanding the term commercial engineer. The big problem before the industry was concerned with interconnection of power, the purchase and disposal of power, &c., matters that only the engineer could properly understand. The financial man could not appreciate the various interests involved, and he had to fall back on the commercial engineer. Among the subjects the engineer must grasp were true cost, money, obsolescence, depreciation and the sinking fund against loss of tenure, &c. In the case of power factor, for instance, there was a serious danger of the ultra-scientific man devising tariffs to meet this problem that were uncommercial.

Mr. A. F. Harmer suggested that the Americanism "Development Engineer" better expressed the meaning than "Commercial Engineer." In his experience, the last person in a supply concern to listen to the views of the practical engineer was the accountant.

Mr. P. Dunsheath noted that all the speakers seemed to be imbued with the idea that we must fit ourselves for commercial life. Surely that was not an insuperable difficulty, having regard to the intensive training an engineer required. Compared with other professions, like law and medicine, the engineer was not handicapped except that his duties required greater accuracy. A doctor's mistake might cost a human life, but an engineer's mistake might mean a thousand lives.

Mr. E. F. Hetherington thought the commercial knowledge required by the engineer was only a common-sense knowledge of the world. Colleges should give a course upon bold lines, showing that there is nothing sordid and mean in aiming at selling brains to the best advantage or one's output at a profit.

Messrs. R. Grierson, F. Sclater, A. Rosen, G. V. Twiss, P. Rosling, W. E. Rogers, and R. W. Hughman also spoke.

Mr. Gill, in his reply, said he would be sorry if anything he had said could be interpreted as inimical to pure research or industrial research. The engineer was the man who applies science economically. With regard to economic training there should be a way of giving such training without unduly lengthening the school courses. It could be inculcated in an occasional hour's lecture that would be turned over in the students' minds. He agreed that if the engineers would talk to the financial men in their own language they would get a welcome hearing. The accountant was perhaps a difficulty, but the overcoming of difficulties was the engineer's job.

PLANT FOR MALAY STATES RAILWAYS.—In the report on the Federated Malay States Railways for the past year, mention is made of the addition to the rolling stock of new locomotives from Scotland and America. Twenty "B" class locomotives from the North British Locomotive Works, Scotland, and ten "R" class locomotives from the Baldwin Locomotive Works, Philadelphia, were received during the year. Ten "M" class locomotives ordered for the Construction Department in 1920 were received and erected during the year. The open line stock of locomotives, including four steam rail motors, was 233 on December 31st last, as against 204 in the previous year. A large number of new machines were installed in the workshops, and one 60-ton and one 20-ton weighbridges were newly erected at Seremban and the General Stores, Central Workshops, Kuala Lumpur, respectively. One 60-ton weighbridge was received from the Crown Agents during the year for the workshops, but was not yet erected. Seven bogie passenger carriages were newly built at the works and turned out for traffic, and twenty mail type bogie passenger carriages were under erection at the end of the year. Twenty-eight bogie goods wagons were built, and sixty-three wooden wagons. In addition to these, 160 steel covered goods wagons were erected at Port Swettenham by Messrs. D. G. Robertson and Co. These are part of the 500 steel covered goods ordered from England in 1919.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

**The General Situation: Foreign Competition.**

THE unsteadiness of the franc consequent upon the rapid depreciation of the German currency is aggravating the difficulties of iron and steel masters in this district, and this week they have had to compete with keener competition from the Continent than ever. The foreigner has cut his quotations to such an extent that home producers at once recognised the impossibility of countering the move by price reduction. They have adopted an attitude of inaction and are awaiting developments. Such subsidencies as have occurred this week annul the price reductions which British producers have effected in the hope of getting back into the markets and destroy that confidence amongst buyers which is so necessary to stimulate forward buying. Apart from this foreign invasion the iron and steel industry has no fresh feature, and remains quiet in tone.

**Manufactured Iron.**

The Staffordshire manufactured ironworks continue rather badly off for work, but an increase in inquiry is noted, and it is hoped that some of these will shortly materialise into actual business. The tone of the market is increasingly confident, but orders are still slow. Prices cannot be said to be strong, though it is commonly said that current prices do not cover the cost of production, and some ironmasters continue to fight to keep values up. The placing of some shipbuilding orders has assisted the chain and anchor trade of this area, and makers of marked bars are fairly well provided with orders. Makers of common bars are having to contend with increasingly severe continental competition, and a feature of the Birmingham market this week has been the big drop in prices of Belgian No. 3 iron used by the Darlaston nut and bolt makers. The fluctuation of the exchanges, which is mainly responsible for the low prices quoted by the foreigner, is particularly unfortunate for the Staffordshire ironmaster, who now finds that he has to compete with Belgian iron at the extremely low figure of £6 per ton f.o.b. Antwerp. Adding freight charges to the price named, the cost is about £7 7s. 6d. delivered in the Black Country. This is about £2 7s. 6d. below the price asked by most makers in Staffordshire and Lancashire. Local ironmasters cannot, at a profit, sell competing iron under £9 15s., and the disparity is such that consumers in the nut and bolt trade can scarcely be expected to ignore it. Although the foreign iron is finding considerable sale, business has been placed at £9 15s. this week with home makers, and demand would appear to be expanding. Some local makers are stiffer in their attitude with regard to prices than they were a week ago, and one does not hear so frequently of the recent £9 10s. and £9 12s. 6d. quotations. It is, however, still possible to purchase material at these figures. Those consumers who have placed orders on the Continent find the Belgians are prompt to follow any recovery in the franc value, and there are complaints of delays in delivery supposed to have some connection with these fluctuations. There is less activity again in the fencing iron branch, though the £9 17s. 6d. quotation has not been altered. Gas tube strip at £10 10s. to £10 15s. is barely remunerative, but in face of steel strip at as low as £9 5s., sellers cannot easily ask for more. There is naturally a preference for the cheaper material. Strip makers are now feeling the advantage of the slight revival in the tube industry.

**Steel.**

Steel prices are substantially unchanged, notwithstanding keen competition from the Continent. Consumptive demand is less sluggish than it was a month or two ago, but the tone is tentative, and the sudden drop in continental prices tends to increase the caution of consumers rather than to stimulate buying. Plates, angles, joists, billets and other steel products of German, French and Belgian origin have depreciated abruptly with the currency collapse, though not to its full extent. Somewhat curiously home prices have not been perceptibly affected by this competition, and there is a disposition amongst steel masters in this area to await developments. It would almost seem that the home producer is more concerned at the moment with what his immediate neighbours are doing than with the reactions of foreign currency deterioration. There is keen competition between the different districts in England and Scotland, and while the officially declared prices have not been formerly altered, they are cut in all directions. Production costs peremptorily forbid any attempt to assimilate home prices with those which have been precipitated by the artificial conditions of which continental trade is the sport. In the steel bar branch, where production seems to be in excess of demand, home makers have to do business in face of such quotations from abroad as £6 12s. 6d. f.o.b. Hamburg. Foreign billets have this week been offered at £6 10s. for 2in., and £6 5s. for 4in., a fall on the week of 5s. to 7s. 6d. per ton. These figures are much below home prices. But English billets are none too plentiful just now, some of the most important mills being idle, and some firms, in spite of the above-mentioned foreign quotations, are stated to have raised their price to £7 2s. 6d., explaining that recent prices have involved an actual loss. Belgian wire rods are this week offered at £7 15s. f.o.b. Antwerp, or, roughly, £9 2s. 6d. delivered in this district, which compares with the lowest home price for inland delivery of £10, and probably £9 15s. for shipment orders by firms on the South Wales coast. The chief effect of the violence of foreign price fluctuations has been to engender distrust, and the amount of business which is going abroad is somewhat less than was expected.

**Pig Iron.**

The Midlands continue from the pig iron point of view one of the most unsatisfactory districts in the kingdom. The few furnaces selling iron in this district are happily just able to dispose of their output. There is, however, no disposition on the part of consumers to make forward bookings, and the orders which come to hand are for immediate requirements only, and seldom reach 50-ton lots. Forge iron is the weaker side of the market. At present rates the puddling of iron for conversion into wrought iron is not a paying proposition. There is too much cheap steel about. Consequently, puddling has become to a large extent a lost industry in the Black Country, at any rate for the time being. Where it is done it is primarily to meet the needs of allied concerns. Midland pig iron producers generally cannot get any better price for their output, and they cannot prevent coke prices hardening against them. The recent advance in coke is still maintained with great firmness, one Yorkshire quotation received this week being on the basis of £1 3s. at the ovens, a figure which it is held leaves any possibility of profitable pig iron production altogether out of the question. There is no immediate scarcity of coke, but the position is such as to give the seller the control of the market. Smelters are of opinion that some relief may be forthcoming when the Baltic ports freeze up about a month hence. Coke suppliers have, however, profitable alternative markets abroad.

**Galvanised Sheets.**

The stronger quotations for galvanised sheets have now become general, and corrugated sheets of 24 w.g. are firm, with prices ranging from £7 to £7 10s. f.o.b. The Welsh market has now followed the lead of the Midlands in the upward movement. Most of the foreign consumers have been in the market lately with orders, which promise to keep the mills busy over the turn of the year. The black sheet trade is a little more active, especially in connection with motor building. Tin-plates have also stiffened slightly, 21s. 3d. basis being quoted for C.I. yesterday. Some mills have withdrawn quotations, having sold their output over the next few months.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER, Thursday.

**General Outlook.**

INDICATIONS of a slightly better feeling in the iron and metal markets are still to be noticed, although this week the General Election has naturally been a great hindrance to business. There seems to be an idea about that the slight tendency towards better trade which has been noticed during the past fortnight is likely to develop into substantial improvement; but to me that appears to be exceedingly improbable. We must creep before we walk, and we must walk before we run, and those who are interested in the markets must remember that the creeping and the walking stages are almost sure to be prolonged. The difficulties yet in the way of a general revival of trade are simply enormous, even if we can secure a long period of peace and tranquillity. One does not mean to subscribe to the pessimistic views of Mr. H. G. Wells and his school, and to believe that civilisation is disintegrating and that we are going back to barbarism; but it is obvious that international trade cannot be carried on without some system of exchanges which shall be moderately stable. When we have secured that, then a slow progress towards recovery may begin.

**Copper, Tin, &c.**

The market for standard copper has again begun to move up, and it is suggested that those who have been manipulating tin will turn to the manipulation of copper when they find that they have got the utmost out of the other metal. But copper is not nearly so plastic in the hands of the manipulators as tin, and one doubts whether the time is ripe for any serious rise in the price. The movements in standard copper are not reflected in best selected ingots, and the demand for consumers' copper is much as it has been for some time. Engineers are not buying freely, and consumers generally do not show much disposition to hold stocks. They prefer to buy from hand to mouth, as they want the metal. There is not much to be gained now by this policy so far as ingot copper is concerned, and it is possible that the chance of loss is greater than the chance of gain; but in regard to manufactured copper and brass, one can easily understand the reluctance of the consumer to hold any stock at the current official prices. These prices have not been altered for months, but their stability is no proof of their reasonableness. Reports from America suggest that the consumptive demand for copper in the States is lessening while the output tends to increase; but one cannot put much reliance upon this feature. The market for tin has again shown great strength, and further advances have taken place since I last wrote. People are now talking about £200 per ton for the metal, or if by any chance it should reach that figure they will begin to talk about £250; but one cannot forget that, as a general rule in all speculative markets, the bigger the talk the nearer we get to collapse. The markets for lead have been steady and firm, and there is no indication yet of any return to lower prices. The supplies of lead coming from Spain and Australia to this country are small, and, according to current report, are not likely to increase. The only question is whether Mexican lead will soon begin to reach us in large quantities. It is true that the present prices for lead do not now look so high as they did because of the rise in spelter. When spelter and lead were at about the same price, the position looked absurd. Spelter at over £40 per ton looks too dear, and one does not often see the metal worth nearly two-thirds of the price of copper. One would think that present prices would stimulate production in this country.

**Pig Iron.**

The markets for pig iron in Manchester are more or less in suspense, and probably not much attention will

be paid to them this week until the polling is over. It is a broken week in regard to all business, and one cannot say yet whether there is any probability of higher prices for the local foundry irons. It is noticeable that the Cleveland prices are tending downwards and that the falling off of the shipments to America is beginning to tell on that market, in spite of rather better home trade both locally and with Scotland. Cleveland No. 3 has been quoted at lower prices for December delivery; but this does not preclude an advance in Derbyshire prices, because the latter could go up 2s. 6d. per ton and the former come down 2s. 6d., and yet Cleveland iron could not compete in Manchester or the neighbouring towns. Very little new business is being done here, but there are buyers of Derbyshire No. 3 for delivery up to January and February at 90s. delivered in Manchester. The price for East Coast hematite iron is a little firmer, but on the other hand West Coast is easy, and it is said that the West Coast furnaces are anxious to secure an outlet for the extra production caused by the starting of more furnaces. However this may be, the Manchester consumer can now buy West Coast at less than East Coast iron, and as a rule the West Coast brands are thought to be superior.

**Steel**

There does not seem to be any sign yet of a change in the market for manufactured steel. The orders coming in are for small lots, but in the aggregate they amount to a fair tonnage. The main trouble is that the prices at which sales can be made are entirely unremunerative, and likely to remain so. Reports about continental prices are confusing, but merely because the exchanges are so variable; but one thing is clear, viz., that the prices are so low that there is little chance for the expansion of our export trade in finished iron and steel.

**Scrap**

Steel scrap is rather better again, and sellers here seem hopeful of getting the price up to 60s. Some of the ironworks here are now offering only 60s. for good heavy wrought scrap iron, but only two months ago there was a difference of 25s. per ton in favour of iron as between heavy wrought and heavy steel scrap. The demand for cast scrap for foundry work is very poor. Dealers will sell good machinery scrap at 75s. per ton, but they do not find it easy to secure custom even at this low figure.

**The Engineering Trades.**

In spite of the prevalent election fever the engineering industry in this part of the country has recently commenced to show distinct signs of improvement—an improvement which is not confined to any particular branch, and there is a much more optimistic feeling with regard to the future than has been noticeable for a very long time. A well-known establishment in Stalybridge, which has been closed entirely for some months, has been reopened, and a steel works belonging to the same proprietors is said to be busier than it has been for a considerable time. The chief complaint amongst engineering firms to-day is on the score of prices. Orders are being taken at figures which frequently barely cover the cost of materials and wages—not to mention establishment charges. If continued for long such a policy can only result in financial embarrassment, but in many cases it has been necessary to sacrifice profits in order to find employment for a nucleus of staff. Prices will regulate themselves in due course.

BARROW-IN-FURNESS, Thursday.

**Hematite.**

Evidently the hematite iron trade is improving, for not only is another furnace going into blast at Cleator Moor, but the Millom Company is reported to have decided to put another of its Millom furnaces into blast in the immediate future. All this increase of output is convincing evidence of a bigger demand and better forward buying. With the Clyde getting busier the demand for iron from Scotch users is increasing week by week, and there is every reason to expect a steady increase for some time to come. The Midlands and other districts are showing signs of becoming bigger customers, while the continental trade is developing. Cargoes of pig iron were shipped from Barrow last week to Caen and Tréport. The demand for special qualities of iron is increasing, as also is the trade in manganese and spiegel. The fact that there is little being done in the steel trade locally means that less iron is being used in the works, and emphasises the importance of two more furnaces being put into blast in face of the reduced consumption locally.

**Iron Ore.**

The iron ore trade is slowly improving week by week in view of the increase in the number of furnaces put in, and, further than that, trade with smelters out of the district is gradually improving. There is a bigger consumption of foreign ores, but there are still heavy stocks at the docks, which will have to be cleared before there is an increase in the imports. A cargo arrived from Almeria last week.

**Steel.**

There is not much being done in the steel departments at present, although there have been dispatches from Barrow of rails and fish-plates for Bombay and other ports. They are the completions of the orders which have been executed locally. The hoop mills are still fairly well employed, and there is a certain amount of work going on in the foundries. The latter are hopeful of a better state of trade shortly.

**Shipbuilding and Engineering.**

There are no further orders to report, but there is evidence of better trade in the early future. The particulars of the Orient liner are not out yet, for it is believed that the design is not quite decided upon. Rumours at the moment as to other orders are plentiful, but there is no official confirmation of them. There is a better prospect for engineers, but it will be spring before work gets into full swing.

## SHEFFIELD.

*(From our own Correspondent.)*

**Improvement Proceeding Slowly.**

WAITING for the recovery of the steel trade is slow and rather disheartening work, but at any rate it is satisfactory to be able to report that the progress in the right direction is maintained. As has been the case for some time past, the basic branch of the steel trade is the busiest, and employment at the furnaces is gradually rising to a state of real activity. A good tonnage of billets is called for, on both home and export account, and when the Board of Trade returns for the present month are published they will probably show an increase as compared with October. Preparations are being made for the early re-lighting of further furnaces. At one local works operations are to be shortly resumed on one blast-furnace and two steel furnaces. The acid steel trade, however, makes headway very slowly, and is still in a very unsatisfactory condition.

**Crucible Steel Doing Badly.**

The forges and rolling mills are doing a little better, which means that more semi-manufactured steel is going into the works where it is finished off for engineering and other purposes. The crucible steel and high-speed steel branches, however, are still in the same backward condition that they have been for a couple of years past, and numbers of the furnaces are partially closed. Some firms engaged in the manufacture of these materials have even suffered a further decline of business during the past month or two. Trade with the Continent of Europe, although not impossible, is rendered extremely difficult by the present deflation of currencies, and the large demand for tool steel which Sheffield used to experience from Belgium, France, and Italy has practically ceased to exist. While the file trade is only moderately good, the departments devoted to the manufacture of saws continue to enjoy a very fair measure of trade. There was a falling off on this side a few weeks ago, but activity has now been resumed. Australia and Scandinavia are among the countries which have recently sent good orders forward, and a moderate amount of business is being done with India, but trade with South Africa has receded.

**Unprofitable Working.**

One hears many complaints as to the extent to which price cutting is being carried out in the steel industry, and the way in which this is affecting remunerative working. This movement applies to various centres of steel production, and appears to be traceable to the long period of depression from which the trade has suffered. In their anxiety to get work for the employment of their men, and to avoid losses on the maintenance of idle plant, manufacturers are, it is stated, underquoting each other in the most severe manner. "Reckless," and even "ruinous" are terms by which this process is described in some quarters. It has unsatisfactory results in two directions. In the first place, it compels those who desire trade to accept it on terms which in many cases are unremunerative, and it is to be feared that there is a great deal of truth in the statements that producers of mild steel, whether as ingots, billets, finished bars, wire rod, strip, or in other forms, are to a large extent working for no profit or even at a loss. The second unsatisfactory result of the price-cutting movement is that it checks trade, as it induces buyers to keep their orders back in the hope of further reductions in price.

**Railway and Shipbuilding Work.**

The unsatisfactory state of the railway steel departments of Sheffield attracted the sympathetic notice of Mr. Stanley Baldwin, the Chancellor of the Exchequer, when he visited the city for the Cutlers' Feast last week, and it is to be hoped that the appeal which he included in his speech will bear good fruit. He said that there was no doubt that large corporations, and particularly railway companies, had been, and naturally had been, holding back from committing themselves to large schemes of capital expenditure which in time they would have to undertake. He would, he said, like to urge upon such companies—especially the railway companies, which had now broken the back of the troublesome work of amalgamation—to come forward at the earliest possible moment and give out their orders. Mr. Baldwin's words were re-echoed by Mr. Douglas Vickers the next day, when the guests of the Master Cutler went round the works of his firm. There is no doubt that the railway companies require a great amount of work done. There are such great deficiencies of rails and wagons, as well as tools and many other requisites, that many of the companies are hardly able to carry on, and yet they do not give out their orders. As a result, Sheffield axle, tire, and spring departments are starving for lack of work. It is questionable whether they have been employed to more than a quarter of their full extent for the past couple of years. It is now reported that one leading railway company is dispensing with its old 8-ton wagons, the replacement of which will bring some work to the departments mentioned. At present, most of the orders coming forward are from wagon companies which are interested in the coal trade. The demand for ship-plates is little better, but a pleasing item of news in this direction is the fact that John Brown and Co., of Sheffield and Clydebank, has booked an order for a 20,000-ton Orient liner, similar to the one for which Vickers Limited received an order a few weeks ago. The Parkgate Steel and Iron Company has received an order for 1000 tons of plates for the new floating dock at Southampton.

**The Lighter Trades.**

Cutlery and plate maintain their position as the busiest of all the Sheffield trades at present. New orders this week have not been on quite such a large scale as recently, but at the same time there is a very great amount of work on hand, particularly in the stainless cutlery department. The purchases of stainless steel by the Sheffield cutlery trade this autumn have been larger than at any previous period since the material was first introduced. Unfortunately there is severe competition in the prices of the finished goods, and manufacturers complain of very light profits. A satisfactory amount of export work is on hand, Australia and Canada being good customers. The trade in razors, scissors, and pocket knives shows some improvement, but the competition of German goods, of which there is a great bulk in this country, is still very marked. So far as scissors are concerned, however, some of the Sheffield makers have proved themselves able to deal successfully with this competition. There is little of such competition in silver and electro-plate, and these trades continue to enjoy great activity. The past week has been the busiest of the season, and the rush is expected to last several weeks longer. All the firms are not equally well affected, however, and in some cases the turnover is still unsatisfactory. The principal demand is for spoons and forks, both of the electro-plated and of the new nickel varieties, and there is also a growing request for Britannia metal goods.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**Cleveland Iron Trade.**

QUITE an optimistic feeling prevails in the Cleveland iron trade. Despite the disturbing influences occasioned by the General Election, the market has retained all its strong features, and it may now be stated, with some degree of confidence, that a market for the output of the blast-furnaces is assured to the end of the year. A most encouraging feature at the moment is the extent of the forward business. Not only special Cleveland foundry iron, but also hematite has been sold for delivery up to the end of March next. The continental trade is quiet owing to the violent fluctuations in the exchanges, which gravely embarrass all attempt at business. But it is the home demand which is showing the biggest expansion. The home foundries are busy, and the Scottish demand is steadily improving. Some good sales have been made this week to Scottish consumers, and there has, moreover, been further business for the early shipment of foundry iron to the United States. Altogether the outlook for the pig iron trade is good, and there is absolutely no disposition to shade prices for forward delivery. On the contrary, hematite prices trend upwards, and as coke prices are still unduly high, ironmasters cannot afford to cut pig iron prices. The only iron at all plentiful consists of the inferior qualities, such as forge, mottled and white, and quotations for these might be shaded for a substantial order. The market prices are as follows: No. 1 and siliceous iron, 97s. 6d.; No. 3 G.M.B. Cleveland, 92s. 6d.; No. 4 foundry, 90s.; No. 4 forge, 85s.; and mottled and white, 82s. 6d.

**Hematite Pig Iron.**

It is now almost impossible to buy East Coast hematite pig iron for prompt delivery, and consumers are buying well ahead. The price has advanced to 93s. 6d. for mixed numbers, and 94s. 6d. for No. 1.

**Iron-making Materials.**

A little more activity is reported in the foreign ore trade, and sales of best Rubio have been made at 22s. 6d. c.i.f. Tees. Coke prices vary considerably, but 30s. 6d. appears to be a fair average market quotation for good medium furnace qualities.

**Manufactured Iron and Steel.**

Reports of the manufactured iron and steel trade are more satisfactory. There is a more gratifying volume of inquiries, and not merely inquiries but actual business. There is undoubtedly more confidence abroad, and confidence is the foundation of business. Prices, too, seem to have reached stability, and with a few orders for shipbuilding material now coming forward, the prospects all round are brighter. Makers are less disposed to cut prices, and are inclined to make a stand for better terms.

**The Coal Trade.**

There are no new developments in the Northern coal trade. The collieries are well situated as regards orders, but the market has apparently taken on a rather quieter and easier aspect in most directions. So far as continental trade is concerned, matters are practically at a standstill. In the case of Germany new business is hung up awaiting the result of the present efforts to clear up the vexed question of reparations, and also the attempts now being made to stabilise the German mark at a fixed rate of exchange abroad. Until something more is known of the result of these efforts, there is not likely to be any developments in the way of new trade, while the opinion of many is that unless something is done quickly in that direction, there may soon be a slump in values here. There ought to be a number of railway inquiries from France about now, but advices from there seem to suggest that at current quotations nothing can be done. Purchases, when they are made, are for small quantities, and will continue so until prices come down. Italy, Belgium, and the Scandinavian countries are similarly placed. The colliery position is stated to be very favourable, many pits being well sold ahead on paper, and being inclined to hold out for full prices, but for reasons already stated, the situation even for them is not by any means clear or stable. A great difficulty confronting colliery fitters at the moment is the question of turns, which are hopelessly dislocated by the congestion in the docks and at the staithes. If only there could be quicker and more regular dispatch for waiting tonnage, business would be better, and a probably larger output at the pits could be effected. But, as this hangs entirely on the question of the three shifts at the staithes, it is hoped that this system will soon be re-established. Steam coals are steady for all brands of best or second screened steams, but there are supplies on offer through second hands. Steam smalls are plentiful and are weak. Prime brands of gas and coking are

steady, but second classes can often be discounted. Bunkers are fairly steady all round. Coke is easier for foundry sorts, but in the case of gas coke, supplies are scarce, and the market is firm.

**Shipbuilding**

The shipbuilding industry on the North-East coast is gradually recovering from the severe depression from which it has been suffering during the past two years. This week Richardson, Duck and Co., Limited, of Thornaby, have been successful in booking an order for a fairly large cargo steamer.

## SCOTLAND.

*(From our own Correspondent.)*

**Market Conditions Unchanged.**

No change of importance is noticeable in markets generally. Business on the whole is quiet, with little promise of general improvement this year. During the past week or so everything has, of course, been overshadowed by the General Election, which has, if anything, made markets more unsettled for the time being at least. Buyers both at home and abroad show little inclination to place tonnage of any importance, and transactions are still chiefly of a day-to-day character. Apart from the coal market, prices are generally on the down grade, though nominally showing little change.

**More Shipbuilding Orders.**

The outlook in the shipbuilding industry is brightening, though there is still ample room for expansion. During the first seven months of this year only twenty-one new contracts were reported, exclusive of orders for small barges and tugs, but during the three months which have elapsed since the shipbuilding companies began to discount the ten shillings war bonus in their estimates, forty-seven new vessels have been ordered. Amongst the latest orders secured by Scottish shipyards are one for a cargo steamer to be built at Dundee, another for a 20,000-ton passenger steamer for the Orient Steam Navigation Company, to be built at Clydebank, and another for a 10,000-ton cargo steamer, to be constructed at Dumbarton. Inquiries for new tonnage are increasing, and further orders are confidently expected.

**Pig Iron Easier.**

The situation in the Scotch pig iron trade is hardly satisfactory. The output is still largely disposed of against American contracts, but these shipments are drawing to a close. New business, too, from America is of small dimensions. Further, home demands are small, and unless some expansion takes place the prospect of dull times is likely to be realised. Hematite is nominally unchanged, but foundry qualities are easier.

**Finished Steel and Iron.**

Quietness still dominates the steel and iron trades. Sooner or later the shipbuilding orders will have a beneficial effect on the steel works, but little effect has been noticeable so far. The lack of orders for plates is still very prominent, and great difficulty is experienced in securing specifications for sectional material. Sheets are a little busier. The export demand is increasing, especially from India and Japan. Galvanised varieties are busy, and quotations are likely to increase. Bar iron works are not yet in a position to report progress. A few local orders have helped to improve matters a little at some of the works, but the general outlook is still very quiet. There is a better feeling in the trade, however, and the coming of the New Year may see better times. Re-rolled steel bars have only a moderate inquiry.

**Coal.**

Firm conditions characterise the Scotch coal trade in all districts. The collieries are steadily employed, and outputs are easily disposed of. In the West of Scotland all descriptions of round fuel are in heavy demand, but only small lots are available, and for these strong prices are secured. Washed materials are not too well placed, with the exception of trebles, which are well booked both for export and home delivery. In the Lothians and Fifeshire the ports are busy, and a loading turn of several days is general. Many of the collieries are fully booked this month, and in some instances well into December. Home requirements for gas, electricity and household purposes improve as the season advances, but general industrial demands are very easily satisfied. Aggregate shipments for the past week amounted to 300,521 tons against 317,990 tons in the preceding week, and 322,360 tons in the same week in 1913.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**Coal Trade Outlook.**

INTEREST in trade and industrial matters generally has been subordinated to electioneering during the past week, but the labour proposals regarding nationalisation of mines and collieries and the levy on capital, are subjects which are figuring largely in the issue before the electors. While for the moment business affairs are overclouded, still the coal trade has developed a phase that is interesting though not to its advantage. The tone is quieter, and at one time last week the outlook was regarded with some gravity owing to the extremely adverse movement in the foreign exchanges, more especially as it affected France and coal exports to that country. The franc showed a record depreciation, and, as a consequence, several orders for coals were withdrawn, and, of course, consumers abroad are withholding their hands regarding future requirements. The position is much the same in respect to business for Belgium, and in the case of Italy operations have dwindled owing to shipments to that country having been fairly considerable, so that for the time being its requirements are satisfied. There is, however, this point that the lira has appreciated, and before very long the inquiry from Italy may improve. The general financial situation abroad is nevertheless very uncertain, and is having a bad effect upon business, and in the case of France, unless the exchange rights itself the probability is that this market will feel the unwholesome influence of this fact for some time. The demand has undoubtedly become very quiet for prompt shipment, and in the case of contract inquiries over next year, operations are distinctly dull. Buyers abroad so far are not prepared to come up to the ideas of exporters here regarding prices, and so for the time being there is no activity.

**Shipping Arrangements.**

The majority of the leading collieries have fortunately fairly good order books for the remainder of this month and the early part of next. Furthermore, the South Wales docks are practically full of tonnage, and yet the market for prompt loading is on the easy side. This may appear to many to be inexplicable. One would naturally think that in the circumstances the market would be very firm. The fact is that loading operations at the docks are not proceeding with the smoothness and rapidity that is desirable, and tonnage is being greatly delayed. There are many complaints regarding the system at present prevailing in the matter of the release of coals by the dock company, and it is contended that there should be an investigation in order that an early improvement may be effected, as the present position may become aggravated. The system now adopted by the authorities is that coals shall not be released and brought down from the collieries until a ship has got a berth, and the result is that there are numerous complaints that ships in berth are kept waiting for coals. In this way the shipping appliances are not being made most use of, and, in addition to the time lost at the docks, the position of collieries is jeopardised owing to the difficulty in getting a regular supply of empty wagons.

**Swansea's Trade.**

At the monthly meeting of the Swansea Harbour Trust held this week, it was reported that the trade for October showed an increase over the figures for September of 30,000 tons. The total imports and exports for the nine months ending September 30th last exceeded those of the same period last year by two and a-half million tons, or 127 per cent. The financial result was a profit of £6360 11s. 4d., making £56,348 for the past nine months. This result was described as especially satisfactory, in view of a reduction in shipping rates, which accounted for a falling off in that respect of only £218, and which was made up by a larger volume of tonnage in the port. In October the rates were further reduced. The chairman of the Finance Committee said that he had a feeling that an improvement was already setting in, as during October and subsequently the trade of the harbour had been very brisk.

**Current Business.**

Prices of practically all coals have fallen from their best to a slight extent during the past week, but for the most part this remark applies only to spot shipment, owing to the collieries being unable to get the prompt release of their wagons. The superior coals are at the same time well sold for the next few weeks, and salesmen are not modifying their ideas regarding prices for forward business. Inferior coals are on the easy side, as the inquiry for them during the past few weeks has not been equal to that for the best grades. Best Admiralty large are obtainable without any difficulty at 28s., and second Admiralty large are quoted at 26s. 6d. to 27s. Smalls are unaltered, and cargo sorts are plentiful and cheap. In the anthracite section, with the exception of some of the sized coals, the tone is weaker. Pitwood is better as a result of smaller arrivals of supplies. Patent fuel is quiet, but makers are not reducing their prices, as the high cost of pitch does not enable them to do so.

**Swansea Metal Exchange.**

Welsh tinplate makers have advanced the minimum price of tinplates by another 3d. per basis box, making the minimum 19s. 6d. f.o.b. Bristol Channel ports. Values are steady at 19s. 6d. to 19s. 9d. basis I.C. f.o.b. for December and January delivery.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

DAVIDSON AND CO., Limited, of Sirocco Engineering Works, Belfast, ask us to state that they have moved their London offices to Central House, Kingsway, W.C. 2.

DONOVAN AND CO., of 47, Cornwall-street, Birmingham, inform us that they have appointed Mr. David Alexander, of 43, Mains-street, Waterloo-street, Glasgow, as their agent in Scotland for Ironclad switch and fuse gear.

MR. D. POYNTE RICKETTS, M. Inst. C.E., who recently retired from the post of General Manager and Engineer-in-Chief, Chinese Government Railways, Pekin-Mukden line, has been appointed Adviser in London to that railway.

THE CONSOLIDATED BRAKE AND ENGINEERING COMPANY, Limited, informs us that it has moved its offices from 15, Dean's-yard, Westminster, London, S.W. 1, to Caxton House, Tothill-street, Westminster, S.W. 1. Its new telephone numbers will be Victoria No. 2900/1, and its telegraphic address "Peters, Vic. London."

WE are informed that there has been effected a fusion between the firms of T. Cooke and Sons, Limited, of London, York, and Cape Town, and Troughton and Simms, Limited, of London and Charlton, and that from this date business will be conducted under the name of Cooke, Troughton and Simms, Limited, with offices at 3 and 5, Broadway, Westminster, London, S.W. 1.

G. D. PETERS AND CO., Limited, inform us that their London office has been transferred to Caxton House, Tothill-street, Westminster, S.W. 1. The Consolidated Brake and Engineering Company, Limited, of 15, Dean's-yard, Westminster, and the British Air Brake Company, Limited, of 64, Victoria-street, Westminster—companies of which Messrs. Peters are the sole proprietors—have also transferred their offices within the accommodation thus provided. Telephones, Victoria 2900/1; telegrams, "Peters, Vic. London;" cables, "Peters, London."

## LAUNCHES AND TRIAL TRIPS.

INVERGOIL; "N" standard vessel; built by Harland and Wolff, Limited, to the order of the British Mexican Petroleum Company, Limited; dimensions, 428ft. by 55ft. 5in. by 38ft.; to carry 6900 gross tonnage. Engines, triple-expansion; launch, November 9th.

BOSCHDYK; cargo vessel; built by Harland and Wolff, Limited, to the order of the Holland-America Line; dimensions, 400ft. by 54ft. by 31ft.; to carry 6900 gross tonnage. Engines, Brown-Curtis turbines; handed to owners, October 19th.

DRECHTDYK; twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of Holland-America Line; to carry 1200 tons. Engines, two sets of eight-cylinder four-cycle Diesel; constructed by the builders; launch, October 24th.

CONTRACTS.—We are informed that the Wellman Smith Owen Engineering Corporation, Limited, of London and Darlaston, has secured contracts from the Consett Iron Company, Limited, of Co. Durham, for the bulk of the latter's new steel plant, consisting of the following:—Ten cranes, including charging machines, ladle cranes, magnet cranes, &c., ingot stripper; the design and construction of open-hearth furnaces, soaking pits and reheating furnaces, and the coke oven machinery.

"THE KING'S ENGINEER."—We have just received the first number, dated April, of the "King's Engineer," a journal which is to be produced annually by the King's College Engineering Society and the King's College Old Students' Association (Engineering Branch), and is to record their proceedings. It is interesting to note that the Engineering Society was founded in the year 1847, and is therefore one of the oldest bodies of its kind. We congratulate the Editors on the appearance and make-up of their paper.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—On the occasion of the fiftieth anniversary of its foundation, the Institution of Municipal and County Engineers will have a motion on the agenda for its annual general meeting in June or July, 1923, which will have the effect of restricting after that date admission to corporate membership to engineers who possess a professional diploma or certificate or university degree, awarded after examination by some responsible body. This has been commonly required from applicants for associate membership for a considerable time, but it appears to be the general opinion of the profession that the facilities for obtaining certificates in engineering are now such that experience alone should not be held to entitle engineers to claim equality with those who have obtained certificates in addition to experience. The alteration was recommended for adoption in 1923 at the forty-ninth annual general meeting.

THE INSTITUTION OF CIVIL ENGINEERS' AWARDS.—The Council of the Institution of Civil Engineers has made the following awards in respect of papers printed without discussion in Section II. of the "Proceedings" for the Session 1921–1922:—A George Stephenson Gold Medal to Mr. B. C. Laws, D.Sc. (London). Telford Premiums to Professor Leonard Bairstow, C.B.E., F.R.S. (London), and Mr. A. J. Sutton Pippard, M.B.E., D.Sc. (London); Mr. E. A. Cullen, M. Inst. C.E. (Brisbane); Mr. H. H. Dare, M.E., M. Inst. C.E. (Roseville, N.S.W.); and Mr. F. W. Stephen, M.C. (Aberdeen); and for papers read before meetings of students in London and the provinces:—A Miller Prize and the James Forrest Medal to Mr. F. H. Bullock, B.Sc., Stud. Inst. C.E. (Cardiff); and Miller Prizes to Mr. J. G. Mitchell, B.A., Stud. Inst. C.E. (London); Mr. A. G. McDonald, Stud. Inst. C.E. (London); and Mr. Harry Wolf, Stud. Inst. C.E. (Manchester).

THE JAMES WATT DINNER.—An optimistic note prevailed at the annual James Watt dinner of the Institution of Engineers and Shipbuilders in Scotland, which was held in the Grosvenor Restaurant, Glasgow, on the evening of Friday last. The President of the Institution, Mr. Harold E. Yarrow, C.B.E., occupied the chair, and about 350 members and guests were present. The toast of "James Watt" was honoured in silence. Speaking on "Engineering and Shipbuilding Interests," Lord Provost Paxton referred to the prominent place held by Glasgow as a shipbuilding and engineering centre, and to the prevailing depression in trade. It must, he said, be recognised that cycles of depression and unemployment would from time to time occur, and he welcomed the signs of a slight improvement and hoped that trade and commerce would soon be back to their normal condition. The tonnage output during the year before the war was three and a-third million tons in 1750 vessels; in 1919 the figures rose to 2483 vessels of over seven million tons; while last year the output fell to four and a-third million tons. Only by stabilising the trade and the economic conditions of the country could a return to former times of prosperity be hoped for. While waiting for this improvement it behoved all to exercise patience, forbearance and tolerance in relations with each other, and he was happy to say that, so far as Glasgow was concerned, the last four critical years had been distinguished by those qualities. The Marquis of Graham said that there never was a time when industry was more in need of prosperity. The figures he would quote told their own tale. During the last ten months of the present year the number of ships which had been launched was 107, a total tonnage of 342,000 tons. That was the lowest number of vessels launched in this country for the period during the last twenty years. Compared with the corresponding period last year the total was less by 88 ships and 63,000 tons of shipping, while in comparison with a pre-war year, say 1913, the figures showed a decrease of 111 ships and three-quarters of a million tons. Industry must be got going again, and he hoped that next year would mark increased trade and prosperity in engineering and shipbuilding and the many allied industries. Professor Hele-Shaw responded to the toast of "Our Guests," proposed by Sir Hugh Reid, and as President of the Institution of Mechanical Engineers he took the opportunity of referring to the relation of the work of the Institution to Glasgow. He was glad to announce that the National Certificate had now been extended to Scotland, and that the differences of opinion concerning the method on which the examination should be conducted had been reconciled. An assessor agreeable to both the Institution and the Colleges had now been appointed. He appealed to those employers present to recognise this certificate, which represented a course of training and not merely isolated examinations. He was also interested in establishing in Glasgow a branch of the Institution of Mechanical Engineers, and was now in a position to say definitely that a branch was being formed. The intention was not to compete with other Institutions, but to work side by side in mutual co-operation. In conclusion, he made reference to the proposed visit of the Institution to Glasgow next year and to Lord Provost Paxton's generous offer of hospitality on that occasion. An excellent musical programme had been arranged. The secretary of the Institution, Mr. E. H. Parker, was thanked for the completeness of the arrangements he had made, which resulted in such a pleasing and successful function.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. Coast— | |
| Native | 22/6 |
| (1) Spanish | 22/6 |
| (1) N. African | 22/6 |
| N.E. Coast— | |
| Native | — |
| Foreign (c.i.f.) | 22/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) Scotland— | | |
| Hematite | 5 7 6 | — |
| No. 1 Foundry | 5 1 3 | — |
| No. 3 Foundry | 4 16 3 | — |
| N.E. Coast— | | |
| Hematite Mixed Nos. | 4 13 6 | 4 13 6 |
| No. 1 | 4 14 6 | 4 14 6 |
| Cleveland— | | |
| No. 1 | 4 17 6 | 4 17 6 |
| Silicious Iron | 4 17 6 | 4 17 6 |
| No. 3 G.M.B. | 4 12 6 | 4 12 6 |
| No. 4 Foundry | 4 10 0 | 4 10 0 |
| No. 4 Forge | 4 5 0 | 4 5 0 |
| Mottled | 4 2 6 | 4 2 6 |
| White | 4 2 6 | 4 2 6 |
| Midlands— | | |
| (3) Staffs.— | | |
| All-mine (Cold Blast) | 13 0 0 | — |
| North Staffs. Forge | 3 12 6 | — |
| ,, ,, Foundry | 4 4 0 | — |
| (3) Northampton— | | |
| Foundry No. 3 | 4 0 0 | — |
| ,, Forge | 3 10 0 | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 4 2 6 | — |
| Forge | 3 17 6 | — |
| (3) Lincolnshire— | | |
| Basic | 4 0 0 | — |
| Foundry | 4 2 0 | — |
| Forge | 4 0 0 | — |
| (4) N.W. Coast— | | |
| N. Lancs. and Cum. | | |
| Hematite Mixed Nos. | 5 10 0 | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Scotland— | | |
| Crown Bars | 10 10 0 | 10 10 0 |
| Best ,, | 12 0 0 | — |
| N.E. Coast— | | |
| Crown Bars | 10 10 0 | — |
| Tees | 10 0 0 | — |
| Lancs.— | | |
| Crown Bars | 11 10 0 | — |
| Second Quality Bars | 10 5 0 | — |
| Hoops | 14 0 0 | 13 15 0 |
| S. Yorks.— | | |
| Crown Bars | 12 0 0 | — |
| Best ,, | 12 10 0 | — |
| Hoops | 14 0 0 | — |
| Midlands— | | |
| Crown Bars | 10 10 0 to 10 15 0 | |
| Marked Bars (Staffs.) | 13 10 0 | — |
| Nut and Bolt Bars | 9 12 6 to 9 15 0 | |
| Gas Tube Strip | 10 10 0 to 10 15 0 | |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) Scotland— | | |
| Boiler Plates | 12 10 0 | — |
| Ship Plates ¼in. and up | 9 0 0 | — |
| Sections | 8 15 0 | — |
| Steel Sheets ⅛in. to ¼in. | 10 10 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 16 12 6 |

## STEEL (*continued*)

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. Coast— | | |
| Ship Plates | 9 0 0 to 9 10 0 | — |
| Angles | 8 15 0 to 9 0 0 | — |
| Boiler Plates | 12 10 0 | — |
| Joists | 9 0 0 | — |
| Heavy Rails | 9 10 0 | — |
| Fish-plates | 14 10 0 | — |
| Channels | 13 10 0 | — |
| Hard Billets | 8 5 0 | — |
| Soft Billets | 7 5 0 | — |
| N.W. Coast— | | |
| Barrow— | | |
| Heavy Rails | 9 0 0 | — |
| Light ,, | 10 10 0 to 11 10 0 | |
| Billets | 9 0 0 | — |
| Manchester— | | |
| Bars (Round) | 9 0 0 to 9 10 0 | |
| ,, (others) | 9 10 0 to 10 0 0 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| ,, (Soft Steel) | 12 5 0 | 12 0 0 |
| Plates | 9 0 0 to 10 0 | |
| ,, (Lancs. Boiler) | 13 10 0 | — |
| Sheffield— | | |
| Siemens Acid Billets | 9 10 0 | — |
| Bessemer Billets | 12 10 0 | — |
| Hard Basic | 8 5 0 | — |
| Soft ,, | 7 0 0 | — |
| Hoops | 11 10 0 | — |
| Soft Wire Rods | 10 0 0 | — |
| Midlands— | | |
| Small Rolled Bars | 8 15 0 | — |
| Billets and Sheet-bars | 6 17 6 to 7 0 0 | |
| Gas Tube Strip | 10 0 0 to 10 5 0 | |
| Sheets (20 W.G.) | 11 10 0 to 12 0 0 | |
| Galv. Sheets (f.o.b. L'pool) | 17 0 0 | — |
| Angles | 8 15 0 | — |
| Joists | 9 0 0 to 9 10 0 | |
| Tees | 10 0 0 | — |
| Bridge and Tank Plates | 9 0 0 to 9 10 0 | |

## NON-FERROUS METALS.

| | |
|---|---|
| Swansea— | |
| Tin-plates, I.C., 20 by 14 | 19/6 to 19/9 |
| Block Tin (cash) | 180 0 0 |
| ,, (three months) | 180 17 6 |
| Copper (cash) | 63 7 6 |
| ,, (three months) | 64 5 0 |
| Spanish Lead (cash) | 28 7 6 |
| ,, (three months) | 25 2 6 |
| Spelter (cash) | 37 15 0 |
| ,, (three months) | 36 15 0 |
| Manchester— | |
| Copper, Best Selected Ingots | 68 0 0 |
| ,, Electrolytic | 71 15 0 |
| ,, Strong Sheets | 96 0 0 |
| ,, Loco Tubes | 0 1 1½ |
| Brass Loco Tubes | 0 0 11½ |
| ,, Condenser | 0 1 2½ |
| Lead, English | 27 15 0 |
| ,, Foreign | 26 10 0 |

## FERRO ALLOYS.

*(All prices now nominal.)*

| | Per Ton. | Per Unit |
|---|---|---|
| Tungsten Metal Powder | 1/11 per lb. | |
| Ferro Tungsten | 1/5 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £22 | 10/6 |
| ,, 6 p.c. to 8 p.c. ,, | £21 0 0 | 7/- |
| ,, 8 p.c. to 10 p.c. ,, | £20 0 0 | 7/- |
| ,, Specially Refined | | |
| ,, Max. 2 p.c. carbon | £54 0 0 | 20/- |
| ,, ,, 1 p.c. ,, | £64 0 0 | 22/6 |
| ,, ,, 0·75 p.c. carbon | £72 0 0 | 25/- |
| ,, carbon free | 1/7 per lb. | |
| Metallic Chromium | 4/9 per lb. | |
| Ferro Manganese (per ton) | £15 for home. | |
| ,, Silicon, 45 p.c. to 50 p.c. | £11 2 6 scale 5/- per unit | |
| ,, ,, 75 p.c. | 19 10 0 scale 6/- per unit | |
| ,, Vanadium | 17/- per lb. | |
| ,, Molybdenum | 9/6 per lb. | |
| ,, Titanium (carbon free) | 1/2 per lb. | |
| Nickel (per ton) | £160 | |
| Cobalt | 11/- per lb. | |
| Aluminium (per ton) | £82 to £100 (British Official.) | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| Lanarkshire— | |
| (f.o.b. Glasgow)—Steam | 24/- |
| ,, ,, Ell | 25/6 |
| ,, ,, Splint | 26/- to 28/6 |
| ,, ,, Trebles | 23/6 |
| ,, ,, Doubles | 21/6 |
| ,, ,, Singles | 18/- |
| Ayrshire— | |
| (f.o.b. Ports)—Steam | 24/- |
| ,, ,, Splint | 26/- |
| ,, ,, Trebles | 23/6 |
| Fifeshire— | |
| (f.o.b. Methil or Burntisland)—Steam | 22/3 to 26/- |
| Screened Navigation | 28/- |
| Trebles | 24/6 |
| Doubles | 21/6 |
| Singles | 18/6 |
| Lothians— | |
| (f.o.b. Leith)—Best Steam | 24/6 |
| Secondary Steam | 23/9 |
| Trebles | 24/6 |
| Doubles | 22/- |
| Singles | 19/- |

### ENGLAND.

| | |
|---|---|
| (8) N.W. Coast— | |
| Steams | 29/6 |
| Household | 46/3 to 57/6 |
| Coke | 34/- |
| Northumberland— | |
| Best Steams | 25/6 to 26/- |
| Second Steams | 23/- to 24/- |
| Steam Smalls | 13/- to 15/- |
| Unscreened | 20/6 |
| Household | 25/- to 28/- |
| Durham— | |
| Best Gas | 24/- to 24/6 |
| Second | 22/- to 22/6 |
| Household | 25/- to 28/- |
| Foundry Coke | 37/- to 40/- |

| Sheffield— | Inland. | |
|---|---|---|
| Best Hand-picked Branch | 32/6 to 34/6 | — |
| Barnsley Best Silkstone | 28/- to 30/- | — |
| Derbyshire Best Brights | 24/- to 25/- | — |
| ,, ,, House | 21/6 to 22/6 | — |
| ,, ,, Large Nuts | 19/6 to 22/6 | — |
| ,, ,, Small ,, | 15/- to 16/6 | — |
| Yorkshire Hards | 20/- to 21/- | — |
| Derbyshire ,, | 19/- to 20/6 | — |
| Rough Slacks | 8/6 to 10/6 | — |
| Nutty ,, | 7/6 to 8/6 | — |
| Smalls | 3 - to 5/- | — |
| Blast Furnace Coke (Inland and Export) | 21/- to 30/- | |

### (9) SOUTH WALES.

| | |
|---|---|
| Cardiff— | |
| Steam Coals: | |
| Best Smokeless Large | 28/- to 28 6 |
| Second ,, ,, | 26/6 to 27/- |
| Best Dry Large | 27/- to 28/- |
| Ordinary Dry Large | 26/- to 27/- |
| Best Black Vein Large | 25/6 to 26/- |
| Western Valley ,, | 25/6 to 26/- |
| Best Eastern Valley Large | 24/6 to 25/- |
| Ordinary ,, ,, | 22/6 to 24/6 |
| Best Steam Smalls | 16/- to 16/6 |
| Ordinary ,, | 12/- to 14/- |
| Washed Nuts | 25/- to 30/- |
| No. 3 Rhondda Large | 28/- to 29/- |
| ,, ,, Smalls | 19/- to 20/- |
| No. 2 ,, Large | 21/6 to 22/6 |
| ,, ,, Through | 18/6 to 21/- |
| ,, ,, Smalls | 12/- to 14/- |
| Coke (export) | 37/6 to 42/6 |
| Patent Fuel | 28/- to 30/- |
| Pitwood (ex ship) | 33/6 to 35/- |
| Swansea— | |
| Anthracite Coals: | |
| Best Big Vein Large | 50/- to 55/- |
| Seconds | 40/- to 42/6 |
| Red Vein | 37/6 to 40/- |
| Machine-made Cobbles | 67/6 to 70/- |
| Nuts | 70/- to 72/6 |
| Beans | 42/6 to 45/- |
| Peas | 22/- to 23/- |
| Breaker Duff | 9/- to 9/6 |
| Rubbly Culm | 14/6 to 15/- |
| Steam Coals: | |
| Large | 25/- to 26/- |
| Seconds | 23/- to 25/- |
| Smalls | 10/- to 12/- |
| Cargo Through | 17/- to 20/- |

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

# French Engineering Notes.

*(From our Correspondent in Paris.)*

### Reparations.

THE question of reparations continues to dominate the trade situation. While the reconstruction of sugar factories and the rapid extension of electrical equipments are providing some of the engineering firms with a good deal of work, the participation of the Germans appears to be making much less headway than had been expected. German representatives have visited the devastated regions, and are anxious to supply everything that may be required, but the French are insisting that if the Germans undertake this work they must comply with the terms of the Versailles Treaty, providing for the delivery of specified quantities of coal and coke. So far as coke is concerned, the situation has become extremely precarious for Lorraine pig iron producers, some of whom are obliged to damp down furnaces and to delay putting others in blast. This, too, at a time when they have an abundance of orders for three or four months. There is consequently a dwindling belief in the success of the Lubersac-Hugo Stinnes arrangement, and opinion is veering round again to a policy of exerting energetic pressure upon Germany for the payment of reparations, which means that an occupation of the Ruhr would deprive that country of its industrial resources, and would provide France with everything she requires in the way of coke and other raw materials.

### Commercial Treaties.

It is evident that at the forthcoming Brussels Conference reparations will be bound up with a number of other factors, and the opportunity is a favourable one for discussing the question of commercial facilities which, if solved in a satisfactory manner, would do much to make the situation easier for the various countries concerned. The fantastic fluctuations of the franc during the week have shown that there is an entire lack of any element of stability. They have effectively arrested the improvement that was noticeable in the business relations with Great Britain and other countries with sound currency, and, while the propaganda inviting the French to refuse to purchase British and American goods should not be taken too seriously, it is nevertheless clear that with the present exchange rate, the sale of British goods in this country has become almost impossible. Facilities for trade between the two countries would of themselves provide an element of stability by creating a mutual confidence and interest, and where trade develops it can rely upon the aid of finance. The present situation cannot last indefinitely, and if the forthcoming conference should cover the problem of commercial exchanges it will have rendered considerable service. The only two really great customers of France are Great Britain and Belgium, and the efforts being made to carry out negotiations for a treaty with Belgium may, if successful, be followed by a similar arrangement with Great Britain.

### Air Propellers for Boats.

The idea of driving boats against the wind by means of air propellers presents an interesting scientific problem, and the way in which it has been worked out by three inventors, with the assistance of the Comité des Recherches Scientifiques et Industrielles, appears to indicate that it may have some practical value for canal barges and other small craft. The principle was explained recently before the Académie des Sciences by M. Breton, the director of the Comité des Recherches, and experiments were carried out on the Seine last week in the presence of a number of engineers and scientists, when a boat, 8.50 m. long and drawing 1.80 m. of water, was manœuvred with the new propelling mechanism. On the deck was erected a metallic standard, to the top of which was fitted a two-blade variable pitch propeller 9 m. diameter. The propeller could be turned round at any angle in relation to the longitudinal boat axis. Motion from the air propeller was communicated through bevel gearing at the bottom of the standard to a shaft running in ball bearings and carrying a water propeller 1.05 m. diameter. To ensure the air propeller taking up its most effective position a vane at the top of the standard is connected electrically with a pointer on deck, so that the pilot can keep the air propeller in that position. During the experiments the air velocity was scarcely more than 2 m. per second, but the boat was able to travel against the wind at a speed of from 3 kiloms. to 4 kiloms. an hour. The existing installation is a rudimentary one, and was intended merely to demonstrate the principle and to show the facility with which the boat can be manœuvred. Improvements are now to be carried out in the way of giving an automatic adjustment to the air propeller, and to allow of the standard or mast being lowered when passing under bridges. It is admitted that a stand-by engine must be installed in case of emergency. The trials certainly created a very favourable impression, and it was pointed out that the new propelling system would be particularly useful in countries like Holland, where the winds are fairly steady, while it is also hoped to show its superiority over sails for fishing boats.

### Fuel Economies.

The investigations carried out by the Commission Interministérielle d'Utilisation du Combustible, of which the reports have been summarised in these columns, point to so much progress in the methods employed for the more economical use of fuels for steam raising and other purposes, that the Commission believes the time has come when the whole question should be reduced to a scientific basis. It is, therefore, intended to organise a congress with a view of collecting all the scientific data available, and the results of practical working and experiments, and for that purpose a particularly exhaustive programme has been drawn up covering all the phases of steam raising and of industrial heating generally. The congress will be held next spring. The address of the Commission Interministérielle d'Utilisation du Combustible is at the Ministère des Travaux Publics, 246, Boulevard St. Germain, Paris.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

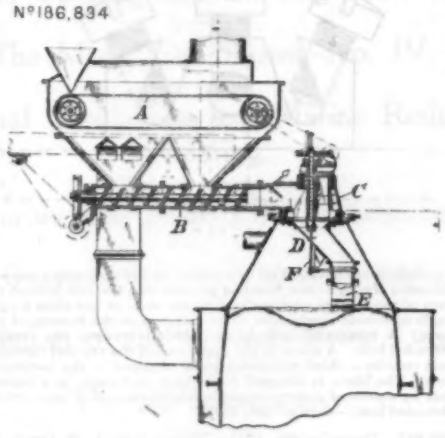
*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

### GAS PRODUCERS.

186,834. October 7th, 1921.—CHARGING GAS PRODUCERS, Merz and McLellan, Collingwood Buildings, Newcastle-upon-Tyne, and 32, Victoria-street, Westminster, London, S.W. 1; E. G. Weeks, 1, Tynedale-avenue, Monkseaton, Northumberland; and A. W. Statters, 47, Alexandra-place, Newcastle-on-Tyne.

THIS specification is concerned with the mechanism for feeding fuel into gas producers, but incidentally mentions the fact that the fuel is pre-heated on a travelling grate A. The fuel is fed forward by the screw conveyor B into the rotary head C of the

N°186,834




retort. A hollow arm D extends downwards from the head and distributes the fuel round the sides of the retort through a trailing shoot E. An indicating mechanism F connected with this shoot shows the level of the top of the fuel bed.—*October 12th*, 1922.

### TRANSFORMERS AND CONVERTERS.

186,830. October 12th, 1921.—IMPROVEMENTS IN AND RELATING TO CASINGS FOR TRANSFORMERS AND OTHER ELECTRICAL APPARATUS, *The British Thomson-Houston Company, of* 83, *Cannon-street, E.C.* 4.

In the construction of transformers in accordance with this invention economy and ease in manufacture are secured. An auxiliary casing A, which acts as an expansion chamber for the oil, is connected to the main casing. Radiating units for increasing the cooling capacity of the casing are arranged as at B,

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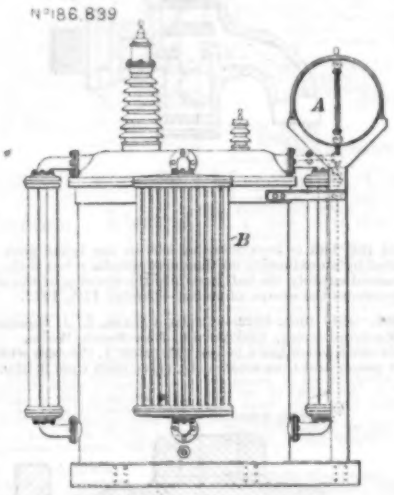


the top and bottom headers in which these radiating units terminate being fixed to the top cover and lower part of the main case by means of flanges. The main casing is completely filled with oil, which expands into the auxiliary chamber A.—*October 12th*, 1922.

### TRANSMISSION OF POWER.

186,768. August 9th, 1922.—IMPROVEMENTS IN LINK BOXES FOR ELECTRICAL MAINS, Francis Thursfield, of the Leicestershire and Warwickshire Electric Power Company, Stockwell Head, Hinckley, Leicestershire; and George Pasmore Cosway, of the Nuneaton Electrical Constructing Company, Limited, of Market-place, Nuneaton, Warwickshire.

The objects aimed at in constructing a link box in accordance with this invention are to facilitate the connection and disconnection of the mains and to reduce the risk of short circuits. On opposite sides of the box there are apertures through which three or more mains A pass. The apertures are plugged with insulating plugs B, which can be removed. Glands D are provided to receive the mains which are attached to the terminals C, the glands being provided with a cover E, that gives access to the terminals C. The aperture F may be in the form of a slot, which will allow the mains to enter the gland vertically instead of endwise. When the mains are in place the slot is fitted with a plate, which is held in place by the cover. The parallely-arranged conductors are spaced apart from one another and from the walls of the box by strips of insulating materials extending across the

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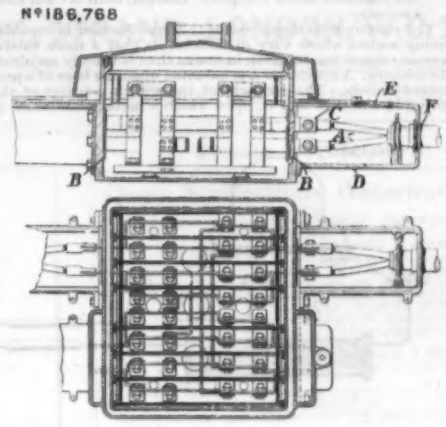


box and supported by pillars carried by members formed of insulating material situated near the base of the box.—*October 12th*, 1922.

186,866. January 14th, 1922.—CHANGE-SPEED GEAR, G. Birley, 30, William-street, Long Eaton, Derbyshire.

In this gear-box all the wheels are always in mesh. A is the driving shaft and B the driven. The lay shaft C is driven through the gear D and carries a series of toothed wheels E. These wheels are engaged individually with the shaft C by means

N°186,866

Fig. 1.

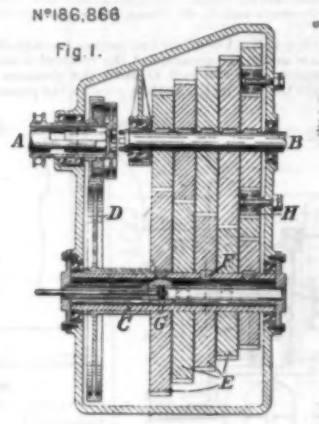

Fig. 2.

Fig. 3.

of the ratchets F, of which a detail is given in Fig. 2. The ratchets are operated by the plunger G. The gear wheels on the driven shaft also are loose, but transmit their drive through clutch members as shown in Fig. 3. A reverse is provided at H, while the driving shaft can be slid forward to engage the driven shaft and give a direct drive.—*October 12th*, 1922.

### ELECTRICAL APPLIANCES.

186,771. August 11th, 1921.—A NEW OR IMPROVED CONSTRUCTION OF INDUCTION COILS FOR CURRENTS AT RADIO FREQUENCY, William Robert Hamilton Tingey, of 92, Queen-street, Hammersmith, London, W. 6.

The construction of the induction coil made in accordance with this invention is fairly obvious from the illustrations. A and B are two plates of ebonite, which are spaced apart by distance pieces C. D is an ebonite bar, over which the wire is passed at the end of each layer of the winding and before proceeding with the next layer. Beginning at the point F, the

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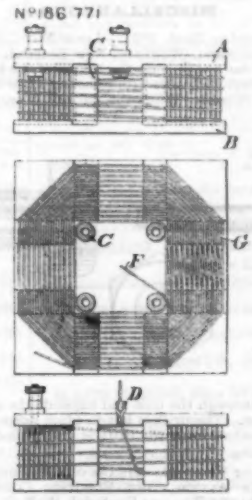


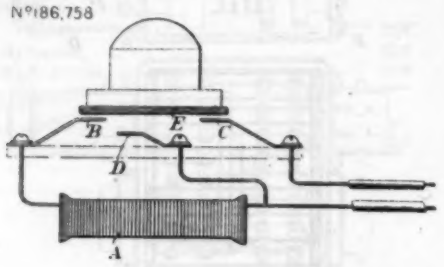

wire is wound several times around the distance blocks C with a space between the convolutions. Spacing strips G are then placed in position around the first layer and the wire is brought up across this layer to near the point of commencement and is then wound over the spacing strips to form the second layer. If desired, the wire may be passed over the binding bar D as shown before commencing the second layer. The remainder of the layers are wound in the same manner. An inductance coil wound in accordance with this invention has low self capacity.—*October 12th*, 1922.

## MOTOR CARS AND ROAD TRAFFIC.

186,758. August 2nd, 1921.—Improvements in Electrically Operated Motor Horns, Reginald Walter Maudslay and the Standard Motor Company, Limited, both of Cash's-lane, Coventry.

The electric horn described in this specification is capable of giving sounds which vary in volume, so that a more subdued warning signal can be given in towns than is usually required in the country. A resistance A is mounted upon the base of a press-button switch. The contacts of the switch consists of three spring blocks B, C and D, upon which a metal plate or strip E

N°186,758




can be pressed by means of the button. It will be seen that when the contacts B and C are connected together the resistance A is included in the circuit, whereas further pressure on the button causes the plate E to make contact with the contact D and to cut the resistance out of circuit. The strength of the warning signal is then increased. An alternative arrangement is also described.—*October 12th*, 1922.

## PUMPING AND BLOWING MACHINERY.

186,822. September 23rd, 1921.—Controlling Air Compressors, A. Goodwin and F. W. Pratt, 56, Sumner-street, Southwark.

The double-beat inlet valve A of an air compressor is controlled by the piston B. Air under the pressure of the receiver is delivered at C, but cannot pass the ball D until the pressure is sufficient to overcome the weight E. It then goes by the passage

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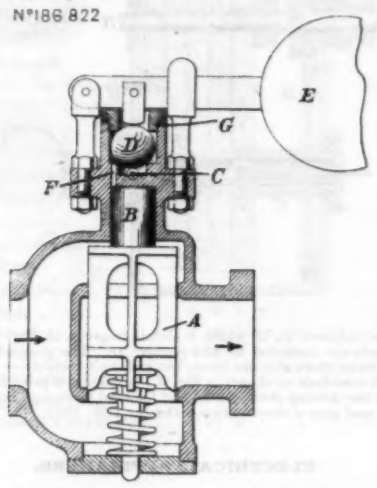


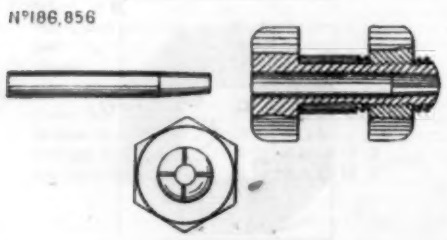

F to the piston B and closes the inlet valve. At the same time the ball D is lifted against its upper seating G, which is slightly larger than the lower seating. The result is that the ball is not pushed down by the weight E, to close the passage F, until the air pressure has fallen to an extent proportionate to the difference in diameter of the two seatings. By changing the weight E and the size of the seating G the pressure variation can be controlled. —*October 12th*, 1922.

## MISCELLANEOUS.

186,856. November 22nd, 1921.—Lock Nuts, J. T. Meredith, 19, Herbert-street, Waimate, New Zealand.

The inventor bores a hole up the length of the bolt. This hole finishes, at the nut end, with a diminishing taper as shown. The end of the bolt is split. When the nut has been tightened up a

N°186,856



drift is driven through the hole and expands the end of the bolt, securing the nut. The drift is left in place normally, but if the nut is to be slacked back the drift is first pulled out.—*October 12th*, 1922.

186,467. October 5th, 1922.—Means of Introducing Capacity Effects in Alternating Electric Current Systems and Apparatus, Thomas Frederick Wall, D.Sc., Carr Bank House, Fulwood, Sheffield.

The inventor proposes to improve the power factor by means of secondary cells connected to alternating current circuits, and gives particulars of some tests that have been made. A pair of plates consisting of lead grids were pasted with red lead, such as is used in the manufacture of the positive plates of a lead accumulator before conversion by "forming" into the higher oxide. These were immersed in an electrolyte of dilute sulphuric acid having a specific gravity of 1.16. A leading reactance voltage (root-mean-square) of 2.0 volts was obtained at 1.65 cycles per second on an electrode area of 16 square centimetres per ampère. A pair of similar grids pasted with the lower oxide, such as is used in the production of negative accumulator plates, and immersed in sulphuric acid of 1.18 specific gravity gave a leading reactance voltage (root-mean-square) of 2.3 volts at 1.57 cycles per second on an electrode area of 16 square centimetres per ampère. A periodicity of 1.57 cycles per second corresponds to 3.14 per cent. slip on a 50 cycles per second induction motor. If 800 square centimetres of one electrode per cell are provided and a current of 50 ampères passed, the leading reactive volt-ampères per cell for plates pasted with the lower oxide of lead will be 115. By providing six such cells and connecting two in series in each phase in star or mesh connection to suit the characteristics of an induction motor the leading reactive volt-ampères in the secondary circuit will be 690, and the equivalent in the primary circuit will be 22 kilovolt-ampères. This is sufficient to correct the power factor of a 45 horse-power motor from .70 to .90 lagging.—*October 5th*, 1922.

186,807. September 3rd, 1921.—Improvements in Terminal Blocks for Electrical Conductors, Allen Kirk and Robert Cecil, of 14, Victoria-street, S.W. 1.

This invention relates to improvements in terminal blocks of electric conductors for use with switches, ceiling roses, junction and joint boxes, bonding blocks, &c., and has for its object to facilitate the fixing of the conductors. The terminal block is provided with two slots diverging outwards from the top surface on either side of a vertical threaded hole. The outer ends of the

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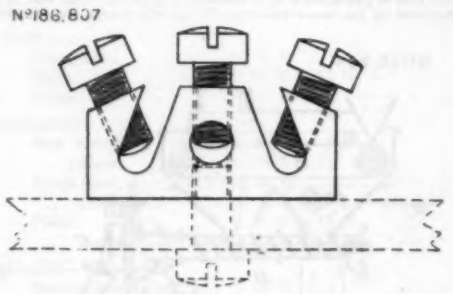

top surface are bevelled off at an angle to the slots and a screw is threaded through each bevelled portion into the slot so that the axes of these screws are inclined to the slots at less than a right angle to enable conductors to be clamped in the bottom of the slots. A horizontal hole in the block intersects the vertical threaded hole. A screw in the upper end of the vertical threaded hole enables a third conductor to be clamped in the horizontal hole. The block is clamped to its base preferably in a sunken seat by means of a screw engaging the lower end of the vertical threaded hole.—*October 12th*, 1922.

186,862. December 6th, 1921.—Water Taps, C. H. Davis, 24, Finborough-road, West Brompton, London, S.W. 10, and K. E. Schweder, Palmerston House, Broad-street, London, E.C. 2.

In order to permit the tap being taken to pieces for the renewal of its washer the inventors place a ball of buoyant material in a chamber below the valve seating. In ordinary

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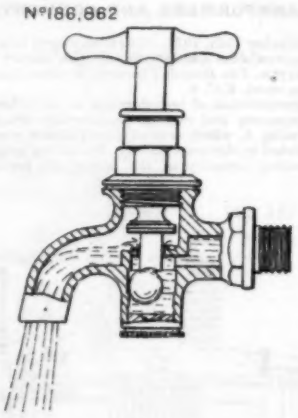
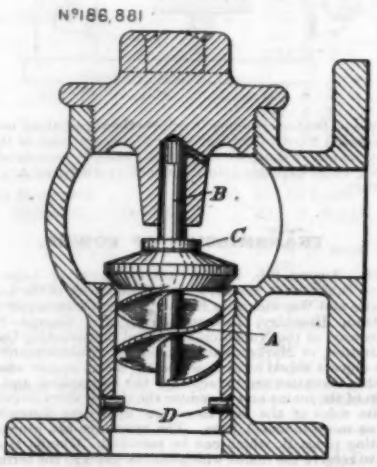


service this ball is kept more or less in the lower part of its chamber by an extension on the valve spindle; but if the valve is removed entirely the ball rises into the opening of the seating and prevents the escape of water.—*October 12th*, 1922.

186,881. July 10th, 1922.—Check Valves, L. J. Rossiter, 14, Rochford-street, Erskineville, New South Wales.

This check valve has a helical extension A, through which the water passes and thus rotates the valve each time it lifts. The

N°186,881




valve is guided by the stem B and its lift is limited by the thickness of the washer C. The seating is provided with pegs D to engage with a key for screwing it in or out.—*October 12th*, 1922.

# Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### TO-DAY.

The Institute of Chemistry.—The dinner arranged for this evening has been postponed on account of the General Election.

Faraday House Old Students' Association.—Hotel Cecil. Annual dinner. 6.30 for 7 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "The Ford Car: Its Design, Production and Service," by Mr. Sam Evans. 7.30 p.m.

The Junior Institution of Engineers.—39, Victoria-street, Westminster, S.W. 1. Forty-first annual general meeting. 7.30 p.m.

The Institution of Electrical Engineers: Scottish Centre, Students' Section.—Royal Technical College, Glasgow. Opening address by Mr. J. F. Nielson. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Notes on Torsional Oscillations with special reference to Marine Reduction Gearing," by Messrs. A. T. Thorne and J. Calderwood. 7.30 p.m.

The Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Adjourned discussion on "Electric Locomotives," by Sir Vincent L. Raven. 6 p.m.

Royal Society of Arts: Indian Section.—John-street, Adelphi, W.C. 2. "The Development of Water Power in India," by Mr. J. W. Meares. 4.30 p.m.

### SATURDAY, NOVEMBER 18TH.

The Junior Institution of Engineers: North-Eastern Section.—Visit to the works of the Michell Bearing Company, Scotswood.

The Institution of Automobile Engineers.—Visit of the London Graduates to the works of H. Collier and Sons, Limited, Burrage-grove, Plumstead, S.E. 18. Meet outside the works, 2.30 p.m.

### MONDAY, NOVEMBER 20TH.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Debate on "The High-compression High-speed Engine v. the Low-compression Medium-speed Engine. 7.30 p.m.

The Institution of Automobile Engineers.—The College, Loughborough. Graduates' meeting. Paper, "Front Wheel Braking Systems," by Mr. P. H. Goffey. 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Informal meeting. Discussion on "Electric Light Wiring," opened by Mr. F. J. Pearce. 7 p.m.

The Institution of Civil Engineers: North-Eastern Association.—Bolbec Hall, Newcastle-upon-Tyne. Presidential address by Mr. R. F. Hindmarsh. 7.30 p.m

### TUESDAY, NOVEMBER 21ST.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Paper, "Underground Waters in the Kent Coalfield and their Incidence in Mining Development," by Mr. E. O. Forster Brown. 6 p.m.

Institute of Marine Engineers.—85-88, The Minories, Tower Hill, E. 1. "The Evolution of the Nobel Diesel Engine," Part. II., by Mr. G. J. Steinheil. 6.30 p.m.

### WEDNESDAY, NOVEMBER 22ND.

Society of Glass Technology.—The University, St. George's-square, Sheffield. General meeting. 3 p.m.

The Institution of Automobile Engineers: North of England Centre.—Education Offices, Salford. Paper, "A New System of Carburation," by Mr. W. A. Whatmough. 7.30 p.m.

The Institution of Automobile Engineers.—The Chamber of Commerce, New-street, Birmingham. Inter-debate with the Coventry Graduates on the Motor Exhibition from the point of view of "Accessibility." 7.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, S.W. 7. Special general meeting. 5 p.m.

Liverpool Engineering Society.—Royal Institution, Colquitt-street, Liverpool. Paper, "Stability of a Pile Wharf," by Mr. S. H. Ellis. 8 p.m.

The Association of Drop Forgers and Stampers.—Chamber of Commerce, Birmingham. Lecture, "Drop Forging Practice: I., Preliminary Forging," by Mr. D. L. Aitchison. 7.30 p.m.

### THURSDAY, NOVEMBER 23RD.

Liverpool Engineering Society: Students' Section.—Royal Institution, Colquitt-street, Liverpool. Paper, "The Design of Pontoons," by Mr. K. S. Dodd. 7.30 p.m.

The Institution of Locomotive Engineers, London.—The Engineers' Club, Coventry-street, W. 1. Paper, "South African Railways and Rolling Stock," by Mr. H. K. Bamber. 7.30 p.m.

### FRIDAY, NOVEMBER 24TH.

The Institution of Production Engineers.—The Engineers' Club, Coventry-street, W. 1. Paper, "Standardisation," by Mr. G. Hey. 7.30 p.m.

The Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Notes on Waterworks Plant in India," by Mr. F. E. Murrell. 7.30 p.m.

The Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Adjourned discussion on Paper on "Air Compressors," by Mr. W. Reavell. 6 p.m.

### TUESDAY, NOVEMBER 28TH.

The Institute of Marine Engineers.—85-88, The Minories, Tower Hill, E. 1. Film illustrating the "Conquest of Oil," the Anglo-American Oil Company. Ladies' night. 6.30 p.m.

### WEDNESDAY, NOVEMBER 29TH.

The Newcomen Society.—The Iron and Steel Institute, 28, Victoria-street, S.W. 1. Annual general meeting. Paper, "Notes on the Early History of Steel Making in England," by Mr. Rhys Jenkins. 5 p.m.